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Broken Hill: Australia's Greatest Mining Camp

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Among Australia's many spectacular and important mining camps Broken Hill stands foremost. Since its discovery a half century ago that center has produced minerals worth more than two-thirds of a billion dollars. As a source of lead and zinc it ranks among the world's outstanding producers.

Although years of mining are still in prospect at Broken Hill the zenith of production took place as long ago as 1913, and the ultimate near-extinction of the community is inevitable, for non-mining activities of the district cannot justify the continuance of an urban center approaching present size.

GENERAL CHARACTER OF BROKEN HILL DISTRICT

Broken Hill is situated among the Barrier Ranges in western New South Wales, 35 miles from the South Australian border and 700 miles from Sydney (Fig. 1). The general elevation of the district is about 1,000 feet above sea level and the scattered northeast-southwest trending ranges rise some 100–300 feet above the undulating plateau surface. Between the barren rocky ranges sweeps the desert with its monotonous miles of reddish and gray soils sparingly covered by growths of salt bush and blue bush. Scattered mulga trees, which may present a dense growth about the margins of ranges, and gallery forests of redgums (eucalypts) along the sandy

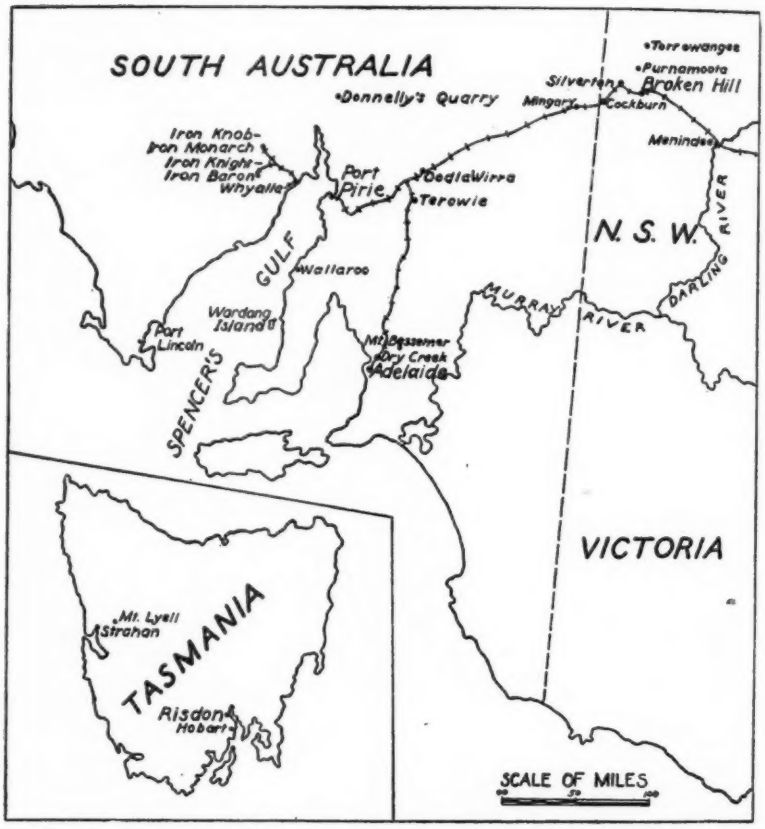


FIG. 1.—Broken Hill and its principal external relations. Its close relationship to the State of South Australia is brought out.

stream courses lend some variety to the generally desolate and dust-covered landscape.

An annual rainfall of about 10 inches and an evaporation rate of about 7½ feet, summer temperatures of 100–115° F. with frosts in winter, and frequent severe wind storms characterize the climate. The rapid growth of ephemeral grasses and flowering plants following good rains temporarily provides a marked contrast to the usual barrenness and to the dull greens of the xerophytic species.

OCCUPATION BY SQUATTERS

Early recognition of the fact that salt bush would sustain sheep and cattle at times when other feed was not available led to the penetration of the Broken Hill area by graziers. The Mount Gipps station of 1,400 square miles occupied much of the land in the immediate vicinity of Broken Hill.[1] The station headquarters were located along a small tributary of Stephen's Creek several miles northeast of Broken Hill (Fig. 2). Woolsheds, store-

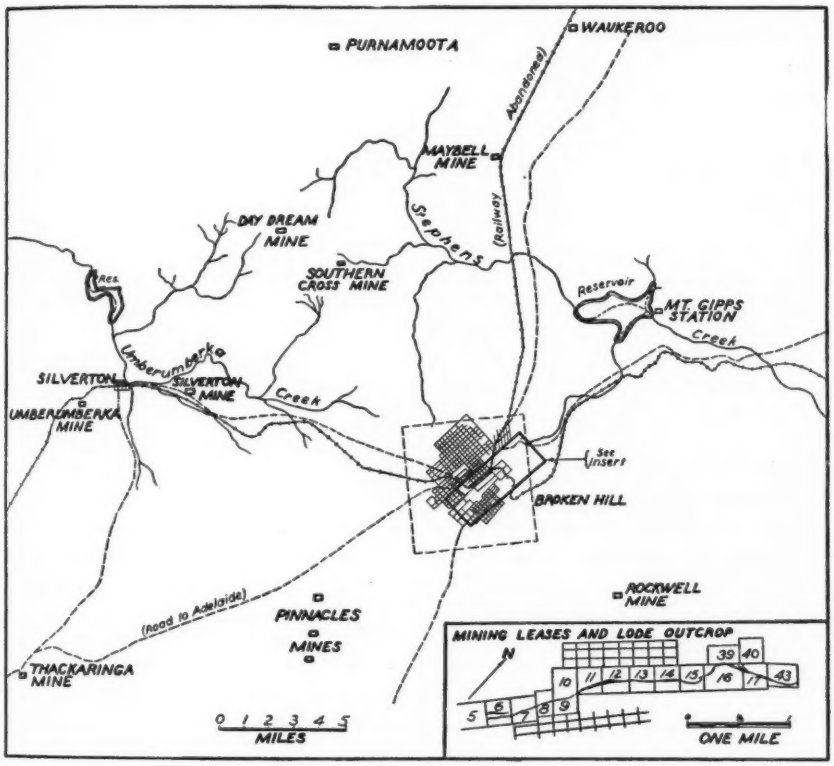


FIG. 2.—The mining district centered on Broken Hill.

[1] Bridges, Roy: *From Silver to Steel,* Melbourne, 1920, pp. 29–30. The term "station" refers to a large tract of land devoted to sheep or cattle raising. Originally it applied to the house and other buildings on a sheep run; now more generally it signifies the land with its improvements, on both sheep and cattle runs.

rooms, quarters for station hands, and stock enclosures were situated on a high bank of the creek. The stream gravels provided a reliable source of water despite the fact that the creek was usually without surface flow. Overlooking the iron-roofed station buildings from a slight rise was the substantial brown stone dwelling of the manager. A wide verandah with stone flooring provided an outlook over much of the station's none-too-reliable holdings. Numerous small dams distributed about the area held portions of the run-off for stock water. Stations of similar type and all subject to severe losses in years of exceptional drought were scattered throughout the district.

A drover's route, over which stock from interior Queensland and northwest New South Wales moved toward Adelaide, crossed the Broken Hill district from north to south. A branch route tapped the Darling River country (Menindee) to the east of Broken Hill. Grog shops and supply stores stationed at suitable places along the "tracks" catered to the needs of drovers and station hands alike.

DEVELOPMENT OF BARRIER SILVER FIELD

The presence of veins of quartz in the Barrier Ranges early attracted the attention of "fossickers"[2] still fired with enthusiasm gained in the Victoria gold fields. During 1867 an unsuccessful rush to the vicinity of Broken Hill occurred but no gold was found and drought took its toll from among the prospectors.[3]

Soon after 1880 silver was discovered at Umberumberka and at numerous other places in the vicinity of Broken Hill. Some deposits proved to be small pockets while others developed into productive mines giving importance to the Barrier Silver Field. The district was about 30 by 70 miles in extent and stretched from Thackaringa and Rockwell on the south, to Corona and Eurowie on the north, some 50 miles beyond the northern limit of the area shown on the map (Fig. 2).

The camp of canvas at Umberumberka Creek became the hub of the silver-producing district. A reliable source of water in the creek bed established the site of the settlement, the principal mine being two miles to the west. Hundreds of miners came to Umberumberka along the earlier established stock and wagon routes which focused there. To that place returned the successful prospectors eager to spend a part or all of their accumulated earnings.

[2] A term commonly applied in Australia along with "digger" to prospectors or miners of gold or other minerals.

[3] Stephen, J. F.: Broken Hill article in *The Australian Encyclopaedia*, 1927, Vol. I, pp. 205–6.

The aboriginal name proved too difficult and it was changed to "Silverton." In September 1883 its population was 250 and in another year it reached 1,750. At the height of its decade of exuberant life Silverton had a population of about 3,000 persons.[4] Today it is a mere clump of houses along the railway.

Among the more important mines developed within a 15 or 20 mile radius of Silverton were Thackaringa, Day Dream, Southern Cross, Maybell, Purnamoota and Pinnacles (Fig. 2). Small settlements were developed in connection with each of them but all were shortlived as were the mines to which they owed their existence.

THE RISE OF BROKEN HILL

The successful production of silver at many points in the vicinity naturally caused the persons employed on the Mount Gipps station to speculate as to the possibility of mineral occurrence on the black, "broken-backed ridge" situated on that property. Led by a boundary-rider, who believed the "hill" to contain oxide of tin, seven men formed a syndicate in 1883 and staked out seven claims (State Mining Leases 10–16) of about 40 acres each along the axis of the reef (Fig. 2, Inset Map). Assays proved the outcrop to contain no tin but a little silver.

Drought came and the syndicate was more concerned with saving sheep than with mining. Indeed, the drought threatened all mining activities in the district for a time but with the coming of good rains in 1884 mining proceeded with renewed energy.

The discovery of rich silver chlorides in a shaft on the hill led to rapid extension of mining activities in 1885. Two furnaces were installed in 1886 and with further development it was soon realized that "the broken hill" was by far the richest find in the district.

Meanwhile a town was rising on the flat along the north side of the outcrop. Its location and street pattern had been defined by government surveyors but in close conformity with the orientation of the reef and as near the workings as practicable. The sandy track through the mulga leading to Silverton became the principal commercial row (Argent Street). The names assigned to other streets reflected strikingly the single economic interest of the settlement: Mica, Wolfram, Cobalt, Beryl, Blende, Crystal, Carbon, Nickel, Gossan, Garnet, Kaolin, Bromide, Sulphide, Chloride, Oxide, Iodide, and Slag.

Hundreds of miners moved into the booming settlement and constructed tents and shacks on lots to which they did not trouble to secure title from

[4] Curtis, Leonard S.: *The History of Broken Hill—Its Rise and Progress,* Adelaide, 1908, p. 4.

the government. The government applied the aboriginal name "Willyama" but "Broken Hill" was used by all others. Buildings of various sizes were transported across the desert from less thriving mining centers. Soon Broken Hill displaced Silverton as the principal center of activity in the Barrier silver district and during those feverish years it rivalled the earlier towns of the Victoria gold fields in mad speculation and riotous living.

PROBLEM OF ISOLATION

Difficulties of transporting bullion to seaboard and of securing supplies from the outside constituted one of the major problems in the development of mines in the Barrier Field. The local scarcity of suitable timber for construction and mining purposes, the total lack of agricultural development, and the absence of fuel for working the ore rendered the Barrier silver field almost wholly dependent on distant sources for essential materials. Wagon trains connected the numerous mines with the terminal of the broad gauge (5′ 3″), South Australian railways at Terowie (Fig. 1).

Since the mines, by reason of closer proximity, looked toward Adelaide rather than to Sydney for their seaboard outlet the South Australian government agreed to extend its lines to the New South Wales border at Cockburn, using a narrow gauge (3′ 6″). A private company then constructed a railway to Silverton and Broken Hill on the same gauge. By September, 1887, the mines were connected without break of gauge to Port Pirie (256 miles distant) near the head of Spencer's Gulf, and costs of transportation to the sea were greatly reduced. That railway connecting Broken Hill with Port Pirie later proved to be the most profitable line in the entire South Australian system by reason of its heavy two-way traffic.

THE BROKEN HILL LODE

The outcrop of the Broken Hill lode extended for about 3½ miles in a northeast-southwest direction and portions of it rose as much as 150 feet above the undulating plateau. The lode consisted of a huge longitudinal arch with its apex forming the highest point along the ridge and dipping at both ends beneath the alluvium. At the center of the arch the lode terminated at a depth of about 500 feet but it reached depths of over 2,000 feet at the ends. The width of the lode varied from a few feet to more than 200 feet and it dipped generally at a high angle toward the west or northwest.[5]

Due to the irregular shape of the ore body and the weakness of enclosing rock numerous mining difficulties were experienced. Overhead stoping methods of mining were employed from the outset and waste materials

[5] Andrews, E. C.: "The Geology of the Broken Hill District," *Memoirs Geol. Survey, N. S. W.*, Geology No. 8. Sydney, 1922.

were commonly used for filling the enormous cavities left vacant after extraction of the ore. Extensive timbering was required and subsidences made it necessary at different times to relocate surface structures which had been illogically placed on the hanging wall side of the lode. In later years owing to increasing subsidence of the underground workings an extensive open-cut was made along the center of the lode to a depth of about 300 feet, which literally removed all remaining ore in that section. The oxidized ores were easily won with pick and shovel but as the harder sulphides were encountered increased use of explosives was required.

Squared Oregon timber was utilized for timbering purposes on a large scale in preference to heavy Australian hardwoods which too were relatively inaccessible to Broken Hill. The extensive timbering in dry workings led to underground fires, one of which burned for ten years before it was successfully isolated.

DIVISION OF THE LODE TO FACILITATE DEVELOPMENT

When the immensity of the ore body was fully realized, and, encouraged by spectacular returns from the rich silver chlorides gained from the initial workings, a series of subsidiary companies was established to operate the separate leases distributed along the exposure.[6] Thus, mining became active along the entire length of the reef and Broken Hill burst into prominence as a mining center. In 1889 the town had a population of 17,000 and in 1892 it was 22,500.

A rough estimate of the original reserve at Broken Hill has been placed at about 52 million tons of ore containing something like eight million tons of lead, six million tons of zinc and over three hundred million ounces of silver.

SCARCITY OF WATER

The problem of securing adequate supplies of water was foremost in the minds of early pastoralists in the vicinity of Broken Hill. It was no less a problem for the prospectors whose range of activities was closely restricted by dependable sources of drinking water. With the establishment of large mining centers and the operation of mines and smelters the problem of water supply became truly critical. Due to inadequate water supplies and neglect of sanitation the early Broken Hill settlement was subject to serious epidemics of typhoid as were other mining centers.

Shallow wells in stream beds and "soakages" (water holes) along stream courses provided water supplies for scattered miners but they proved in-

[6] Lewis, Essington: "Fifty Years of Industry and Enterprise, 1885–1935," *The B.H.P. Review*, Jubilee number, Melbourne, 1935.

adequate for larger groups. The high mineral content likewise interfered with boiler operations. Uncertan rainfall and high evaporation losses made surface reservoir storage unreliable and wasteful.

Severe droughts in 1884, 1888, and 1892 threatened the very existence of all mining centers in the Barrier Field.[7] The comparative dryness of the underground workings at Broken Hill forced the mines to depend largely upon outside sources of supply especially for boiler use and for certain other plant needs. During the periods of drought, water was hauled 70 miles by railway from government reservoirs at Mingary, S. A. (Fig. 1). A pipe line, eight miles in length, was laid by the major mining companies to Acacia (midway between Broken Hill and Silverton) where well water was secured from porous limestones. Rathole Creek, a small stream west of Silverton, also supplied water for rail shipment to Broken Hill.

In 1892, an adequate solution to the water supply problem was first attained with the completion of a dam across Stephen's Creek near Mount Gipps station headquarters ten miles northeast of Brokn Hill (Fig. 2). The watershed of 200 square miles provided large runoff following rains and the reservoir elevation of nearly 400 feet above the city made delivery to the mines and domestic consumers easy. The immediate success of the project dispensed with further consideration of a plan to go to the Darling River for a supply. The Stephen's Creek storage was the only important source of supply until 1915 when the Umberumberka reservoir was completed 23 miles northwest of Broken Hill. An 80-foot concrete dam impounded the flow from a catchment of 125 square miles and water was delivered through an 18-inch pipe line across the desert. Both reservoirs have lost much of their original capacity through silting, and two-thirds of the stored water is lost by evaporation. The large amounts of water used in the ore concentration plants at Broken Hill are secured in part from the mines themselves and in part from the city reservoirs. Owing to the high silt content of the raw water, filtering of the domestic supply is essential. The hardness of the city water has caused many residents to collect soft water from house roofs and to store it in large galvanized iron tanks beside the kitchen door. A two-year's supply can be held in the city reservoirs, thus insuring the community against shortage over an extended drought period.

FLUX PRODUCTION AT BROKEN HILL

The production of flux for use in the smelters was an important industry at Broken Hill. Several quarries near Silverton and Purnamoota

[7] Jacquet, J. B.: "Geology of the Broken Hill Lode and Barrier Ranges Mineral Field, N. S. W.," *Memoirs Geol. Survey, N. S. W.*, No. 5, 1894.

(within distances of 5 to 25 miles) produced usable limestone and delivery was made by rail or bullock wagon to the smelters.

In 1892, the Torrowangee railway (3½-foot gauge) was completed 40 miles to the north of Broken Hill where excellent crystalline limestone was available. Large shipments (200 tons daily) moved regularly from Torrowangee to Broken Hill as long as the furnaces continued to operate in direct connection with the mines. The completion of the Torrowangee railway was another serious blow to Silverton for it resulted in the closing of its flux quarries. The later transfer of all smelting operations from Broken Hill to Port Pirie and other centers eventually led to the cessation of all flux production activities near Broken Hill and to the abandonment of the Torrowangee railway.

Iron ore for use as flux at Broken Hill was obtained from Cutana (ten miles south of Mingary) and from Oodla Wirra, the ore being railed to the smelters (Fig. 1).

FUEL PROBLEM AT BROKEN HILL

The problem of supplying fuels for mining operations and even for domestic uses has always been serious at Broken Hill. Scattered small trees in the vicinity were used for fuel as soon as settlement and mining were undertaken. Wood hunting denuded an ever-widening circle of land tributary to the town. Such circles of devastated vegetation are characteristic about all towns and many station headquarters in that portion of Australia and are an important factor in increasing soil erosion. The process goes on to the present time with the automobile truck greatly increasing the radius over which the wood gatherers may operate. Broken Hill is estimated to require 15,000 tons of wood fuel annually, some of which is hauled 100 miles.[8]

Fuels for metallurgy and coal for power development of necessity were introduced from the seaboard, the earlier supplies coming largely from Great Britain and Germany. New South Wales coal and coke came to be used in larger amounts later. Costs of imported fuels were high due to long sea voyages and to the relatively long land transport to the interior. The cost of New South Wales coal was more than twice as great at Broken Hill as at Newcastle where it was mined. The necessity of storing large quantities of coal at Broken Hill to insure against interruptions in the supply added further to the fuel problem.

EFFECTS OF CHANGING ORE QUALITIES

Important metallurgical problems have arisen at various times at Broken

[8] Holmes, Macdonald: "The Erosion-Pastoral Problem of the Western Division of N. S. W.," *Univ. of Sydney Publications in Geography,* No. 2, 1938.

Hill because of changes in the qualities of ores obtained from different levels and from different positions along the lode. Originally the mines produced from the higher levels rich silver chlorides and lead carbonates which were easily and profitably smelted at the mines.[9]

Silver was the profitable metal in the first years of operation and only the richer ores were extracted. Smelters associated with the principal mines produced a silver-lead bullion which was sent to European refineries for separation of the two metals. The high cost of fuel, however, militated against the conduct of smelting operations at Broken Hill and the mines early sought seaboard smelter locations. A smelter was erected at Port Pirie as early as 1889, another at Cockle Creek (near Newcastle, N. S. W.) in 1896, and others at Port Adelaide and at Dry Creek, both suburbs of Adelaide (Fig. 1).

As workings were extended deeper and farther away from the axis of the lode the ores changed to intimate and fine-grained mixtures of the sulphides of lead and zinc (galena and blende) with low silver contents. The complexity of the sulphide ores so completely outmoded the early methods of treatment that many believed the mines would be abandoned after the oxidized ores were extracted. While the treatment of the oxidized ores was simple and highly profitable the treatment of the sulphide ores was difficult and expensive. Upon the development of processes for the separation and treatment of the sulphide ores depended the future of Broken Hill.

A system of gravity concentration was next applied which enabled operators to recover lead and most of the silver ores but most of the zinc ore remained in the tailings. As a result huge piles of tailings containing several million tons of zinc ores accumulated at the mines while portions were used to refill workings. Lead became the principal metal produced at Broken Hill as the silver output declined relatively.

Flotation methods were next gradually developed making possible the production of a lead concentrate and also a zinc concentrate from the slimes resulting from preliminary gravity concentration and milling processes. In 1905 a large plant was established for the purpose of recovering the enormous amounts of zinc which had accumulated in the waste heaps as well as to recover that metal from the current output of ores. Thus zinc suddenly became an important commercial product of the Broken Hill mines along with the lead. Small quantities of zinc concentrates were treated at a distillation furnace at Port Pirie but most were sent to Great Britain, Belgium, and Germany for spelter production. In 1899, the export of zinc concentrates was 50,000 tons but in 1910 it was 469,000 tons. By

[9] Andrews, E. C.: *The Mineral Industry of New South Wales;* N. S. W. Dept. of Mines, 1928, pp. 127–42.

1920 the dumps were exhausted and exports dropped to 271,000 tons. Lead is now the principal product of the Broken Hill mines, silver is second in importance and zinc is third. The annual output of crude ore from the Broken Hill lode amounts to about 1¼ million tons in recent years.

Broken Hill producers have had one notable advantage over competitors elsewhere in the world—a great ore deposit of better than average quality which gave scope for large scale operations in mining, milling, transport, smelting and refining. Among the principal handicaps have been—high costs of fuel, timber and other mine supplies; high labor costs resulting from short working hours, workers' compensation and similar charges; and large expenditures for taxes and royalties.

LEAD AND SILVER SMELTING AT PORT PIRIE

Port Pirie first became associated with the smelting industry in 1889, as has been mentioned, when works were put into operation for the treatment of silver-lead ores. As smelting operations were discontinued at Broken Hill the Port Pirie plant was steadily expanded and improved. Port Pirie was preferred for extensive smelter development over Port Adelaide and Dry Creek, S. A., because of the uniformity in railway gauge between Broken Hill and that point and because an extensive tract of land could be secured with waterfront privileges from the government at low cost (Fig. 3). The break in gauge at Terowie and the prospective high cost of filling tide lands offered near Adelaide discouraged large smelter dvelopment at that center.

The World War interrupted the normal shipment of concentrates by several mines to European smelters, and British concerns were unable to treat the entire output in the emergency. In 1915, most of the mining companies at Broken Hill acquired an interest in the Port Pirie smelters and agreed to send their concentrates there for a period of fifty years. Thus the entire output of lead-silver concentrate from Broken Hill came to be smelted at Port Pirie, where fuels and fluxes could be secured more cheaply and access to world markets was directly available. By the establishment of that plant Australian lead and silver producers became independent of European smelters and refiners and a very significant addition was made to Australian industrial activity.

In 1934, further important improvements were completed at the Port Pirie smelter to facilitate the handling of the great tonnages of materials, and to reduce fuel and power costs. A large Diesel power plant provided electricity wherever it could be used advantageously. An overhead haulage system greatly simplified the movement of materials within the plant. Mechanical handling devices facilitated the handling of ore, flux, coke, and

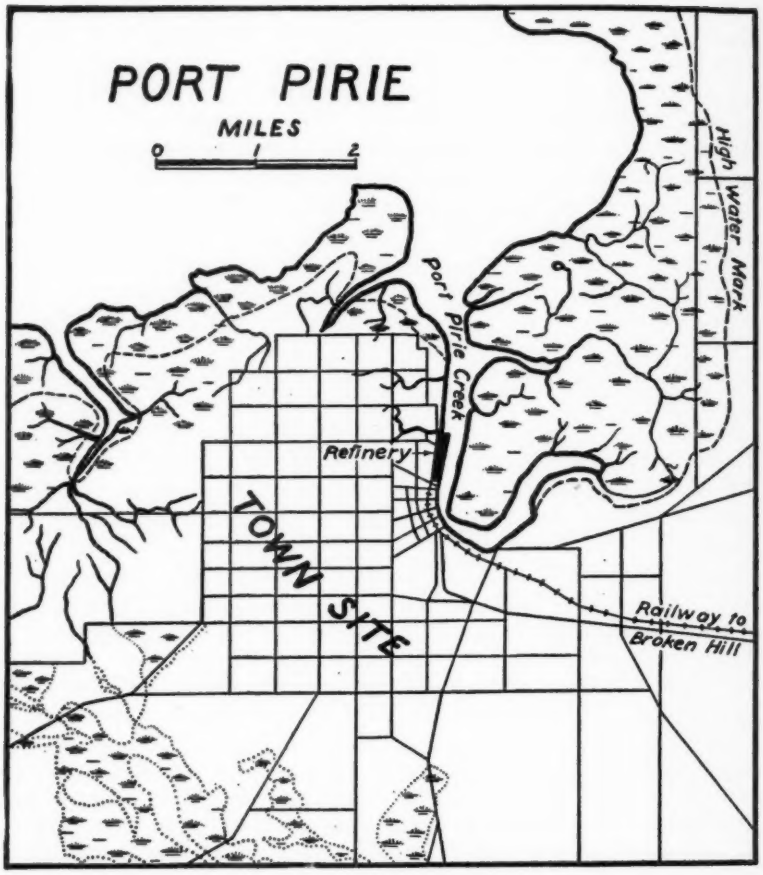


FIG. 3.—The site of Port Pirie.

metals on the wharves. A system of continuous smelting conserved fuel and gave the plant an annual capacity of about 200,000 tons of lead and 8 million ounces of silver.

The slag derived from the Port Pirie smelters contains about 16 per cent zinc. Fuel costs at present prohibit its recovery in competition with other sources of zinc and as a result the slag is allowed to accumulate in great piles beside the smelters, as at Trail, British Columbia, awaiting future possibilities.

FLUX AND FUEL AT PORT PIRIE

The transfer of smelting operations from Broken Hill to Port Adelaide, Dry Creek, and Cockle Creek and ultimately to Port Pirie, necessitated the development of new sources of fluxing materials convenient to each of the new centers of activity. The smelters at Port Adelaide and Dry Creek drew upon small iron ore deposits at Mt. Bessemer and from elsewhere in the Mt. Lofty Ranges just east of Adelaide (Fig. 1). Port Pirie flux was first secured from Donnelly's Quarries (near the head of Spencer's Gulf) and from many scattered small deposits in South Australia. Flux supplies for the smelters at Cockle Creek were drawn from numerous small deposits in New South Wales accessible by railway. The quality varied greatly and no mine produced large amounts.

In 1900, seeking more adequate iron ore flux supplies for the expanding Port Pirie smelters, leases were acquired from South Australia covering the Iron Knob and Iron Monarch deposits on the west side of Spencer's Gulf (Fig. 1). Earlier prospectors sought silver at Iron Knob because of the resemblance of the deposit to that at Broken Hill. A syndicate was formed and shafts were sunk. The ores when tested were found to be iron. Disappointed, the syndicate allowed the original leases to lapse.

In 1901, a 3½-foot gauge private railway (the only one so held in South Australia) was completed from Whyalla, on the gulf, to Iron Knob, 34 miles inland. The railway rose gradually to about 500 feet above sea level and extended through lightly timbered country. Whyalla is only 28 miles across the gulf from Port Pirie and the ore was transferred in barges to the smelter wharf. Open pit and large scale mining enabled the Iron Knob deposit to supply easily all smelter requirements and as a consequence all the earlier developed small quarries were abandoned. In 1915, the great Iron Knob and Iron Monarch desposits became the source of ore supply for the newly created iron and steel industry at Newcastle, N. S. W. The principal source of limestone for flux at Port Pirie has been a quarry on the west side of Wardang Island, in the southeast corner of Spencer's Gulf.

The fuel situation at Port Pirie was improved to the extent of avoiding the cost of railing it inland. The requirements for metallurgical coke became more exacting under the modern system of intensive concentration of silver-lead ores. A proper combination of strength, porosity, burning speed, and ash content was necessary for best results. An extensive coking plant was established at Bellambi, N. S. W., on the South Coast Coal Field in 1901 especially to supply fuel for the Port Pirie smelters. Much coke was also secured from Wallsend, N. S. W., in the Newcastle Coal Field where a strong coke was made in beehive ovens from Borehole Coal.

The recent establishment at Port Pirie of a Diesel power plant to pro-

vide electricity and compressed air for the smelter represents the most recent attempt to economize in power production. It reflects, likewise, the ability of imported petroleum products to compete effectively with Australian coal despite the protective influence of great distance.

In respect to local fuel for domestic use much the same situation maintained at Port Pirie as at Broken Hill. Local wood supplies were quickly exhausted. For a time mallee roots were obtained from the newly cleared wheat lands about the shores of Spencer's Gulf. Imported coal became the principal household fuel as wood supplies became less and less accessible.

OTHER INDUSTRIES RELATED TO LEAD MANUFACTURE

During the World War difficulty was experienced in getting white lead from England, and, too, there was little point in sending Australian lead to England to be returned as white lead or paint. As a consequence a group of British white lead manufacturers and leading mining and refining concerns from Broken Hill united in the establishment of such industries to serve Australian markets. A large factory was constructed on a waterfront site on Sydney harbor and a small plant was operated at Adelaide.[10]

The copper-lead matte and antimonial slag produced at Port Pirie are sent to Port Kembla, N. S. W., for treatment. The Broken Hill mining companies are closely allied with the large copper smelter, electrolytic refinery, and non-ferrous metal manufacturing plant at that center on the South Coal Field.

PRODUCTION AND SMELTING OF ZINC CONCENTRATES

Although small amounts of zinc concentrates from Broken Hill were treated in a plant at Port Pirie, most were exported to German smelters prior to the World War. In 1917 German contracts were abrogated and arrangements were made to ship all Broken Hill zinc concentrates to British refineries while a new plant was undergoing construction in Tasmania. The consummation of that plan brought to Australia new industries of great importance as will now be shown.

In 1909, a concession was granted to a private company by the Tasmanian government for the development of water power to treat complex zinc ores. The company met financial reverses and the power project was acquired by the government and brought to completion in 1916.

The problem of disposing of zinc concentrates in 1917 led to the formation by the Broken Hill mines and others of a company for the purpose of refining and manufacturing zinc products in the Commonwealth. An ade-

[10] Pratt, A. (editor): *The National Handbook of Australia's Industries*, Melbourne, 1934.

quate supply of cheap electrical energy was available in Tasmania and a modern plant was completed by 1921 at Risdon on the Derwent estuary (Fig. 1, Inset Map). The plant was situated three miles above Hobart and was easily accessible to large ocean freighters. Its capacity expanded rapidly to nearly 200 tons of zinc daily and it became the principal user of electricity as well as the largest manufacturing plant in the island. Zinc ores, mined at Mt. Lyell in western Tasmania and shipped from Port Strahan, were also treated at Risdon. The Risdon plant, however, has always been engaged principally in treating Broken Hill ores, since many Tasman mines have operated intermittently in recent years.

The first step in the treatment of zinc concentrates consists of a preliminary roasting in order to drive off the large amount of sulphur and to agglomerate the mass of finely milled material. Since Australia does not possess supplies of native sulphur, the collection of that product from zinc concentrates for the manufacture of sulphuric acid has become an important subsidiary industry. Zinc blende is roasted at Port Pirie and at Risdon for the production of acid to be used in refinery processes or to be sold to other industries. Blende has been roasted in fertilizer works at Wallaroo, Port Lincoln, and Port Adelaide, S. A., and at Cockle Creek, N. S. W., in order to obtain sulphuric acid for the manufacture of super-phosphates. Following the extraction of sulphur the sintered blende is shipped to Risdon where it is subjected to an additional roasting and then to electrolytic treatment. The metallic zinc is cast into 50-pound slabs and dispatched to Australian and overseas markets. Rolled zinc, zinc oxide, lithaphone, and electrolytic cadmium are other products of the Risdon works. Residues from the Risdon plant containing small amounts of lead, silver, and copper are returned to Port Pirie for recovery. The somewhat intricate route patterns displayed in the movements of Broken Hill zinc concentrates is one of the most interesting geographic aspects of the industry. Superphosphates are manufactured in a subsidiary plant at Risdon in sufficient quantities to meet all Tasmanian requirements.

URBAN CHARACTERISTICS OF BROKEN HILL

The impressive array of surface structures related to mining, the colossal heaps of finely divided rock material discarded by ore concentration plants, and the rocky ridge of the mineral outcrop rising above the undulating desert floor comprise the salient landscape features at Broken Hill (Fig. 4). The more accessible and richer middle portion of the lode has been largely exhausted and its mine properties have fallen into disrepair. Mines at the ends are now the more active units (Fig. 5). The "hill" provides an imposing skyline for the squat town development as viewed from

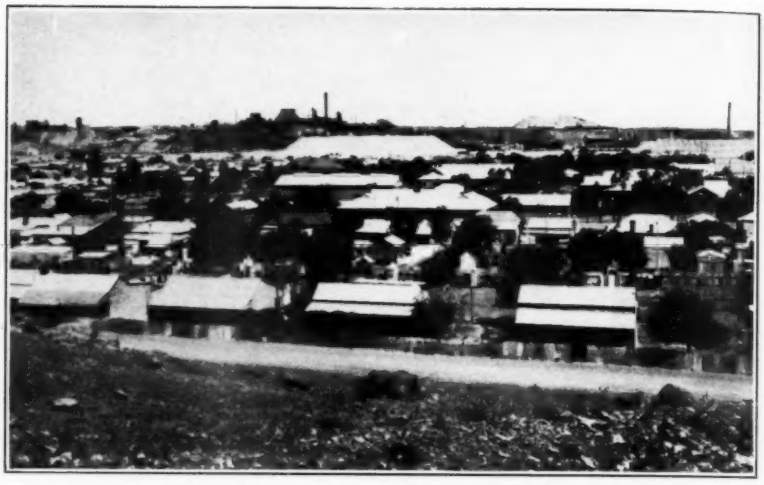


FIG. 4.—The reef with its mining structures and great piles of mill waste is the most conspicuous feature in Broken Hill.

FIG. 5.—Mining structures at the north end of the Broken Hill lode.

FIG. 7.—An isolated suburban home at the edge of Broken Hill. A small orchard and garden are enclosed by a stone wall. Several similar establishments are seen farther out on the desert.

FIG. 6.—Surface structures and huge piles of waste rock material near the center of the Broken Hill reef.

many angles (Fig. 6). Seldom is so much mining activity to be seen in so restricted an area.

The town of Broken Hill is surprisingly compact except for the few residences which occupy scattered sites about its periphery (Fig. 7). The general bleakness of the area, the driving sand storms, and the dependence on facilities easily available only in the town are factors encouraging compact settlement. In places alleyways have become residential streets as was never intended in the original plan, and in places lots have been divided longitudinally, thus crowding houses together unduly.

The street pattern is rectangular and oriented so as to conform with the trend of the reef. The bulk of the town lies on the north side of the outcrop, which corresponds with the side from which the deposit was attacked and on which side most surface mining structures are situated. Two low, isolated, rocky hills in the central town area provide sites for public water distributing reservoirs as well as locations for stone quarries. Residences cling to the lowlands, completely enclosing the minor hill areas.

Streets are excessively wide in most parts of the town and it is usually uneconomical to pave more than the center third, leaving wide sandy or stony strips unimproved. Most residential streets are unpaved, rough, and dusty and they lack sidewalks (Fig. 8).

FIG. 8.—A characteristic residential street in Broken Hill.

Bitumen with gravel is the characteristic paving material in Broken Hill. Ornamental shade trees are more widespread than one might expect to find in a desert town and they consist of native dwarf eucalyptus varieties and introduced Peruvian pepper trees. All residential plots are enclosed with sheet iron fences or stone walls in part to protect them from drifting sand. Such protection is especially necessary about the borders of settlement, where sand drift is most serious (Fig. 9). Some streets have

FIG. 9.—Scattered residences at the margin of Broken Hill. Most of the properties are enclosed to keep out stray stock and drifting sand.

been so filled with sand as to overtop bordering fences and to be made impassable for vehicles. Inside the walls small plantings of figs, almonds, peaches, and grapes are often seen.

Corrugated sheet iron is the outstanding building material in Broken Hill. Mine structures, warehouses, and residences are constructed of wooden frames with roofs and side walls of iron. The material is easily transported and erected, it sheds water and wind, it is non-inflammable, and although it absorbs much heat during the day it cools quickly at night. In dry interior sections of Australia where structural timber is scarce corrugated iron gives character to most human habitations. The widespread use of red roof paint provides striking contrast with the usually drab landscape of the interior. A considerable use of native brown stone (schist) in the construction of many older substantial residences and business houses affords the principal variation in construction material (Fig. 10).

Shade is a much sought feature in Broken Hill. Verandahs cover the sidewalks along commercial streets and where apartments occur above busi-

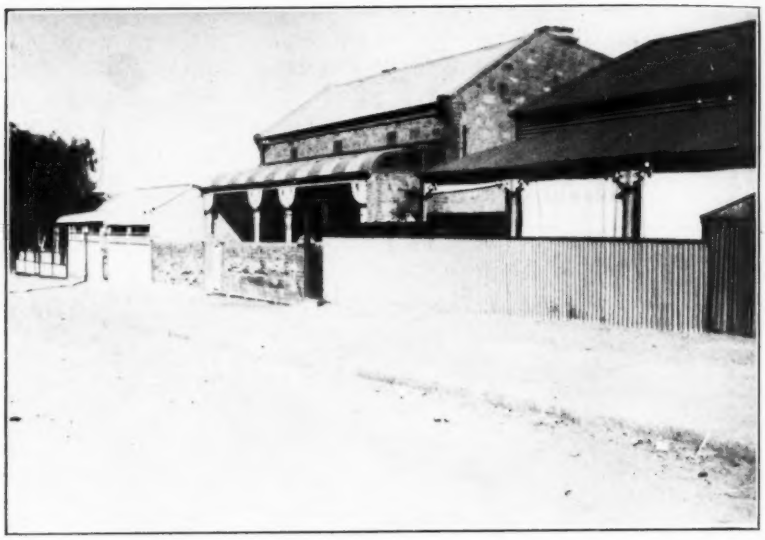


FIG. 10.—A comparison between typical stone and corrugated-iron residences in Broken Hill.

ness rooms second-story verandahs likewise often extend to the curb margins (Fig. 11). Every adequate residence has its wide sweep of verandah across the front.

Broken Hill reflects clearly the transient nature of mining camps generally. No really outstanding public buildings exist and residences are generally inferior to those in the coastal cities. No sewage system has been installed and the entire community utilizes outdoor conveniences which border the alleyways. Many buildings bear construction dates between the late 1880's and early 1900's, reflecting the time in which the town grew most rapidly and accounting for the generally aged and antiquated appearance of much of the community. In recent years the widespread local recognition of the fact that the better days of mining are past discourages improvements which would take place as a matter of course in stable communities.

The town of Broken Hill has always been dependent on the mines for its support. In 1913, when mining was at its peak with 10 mines and 2 treatment plants in operation, the population of the city was 35,000 and 8,700 men were employed. Twenty years later about 6,000 persons were engaged in mining and transportation operations and the town population had

FIG. 11.—The principal commercial street in Broken Hill. The post office tower is the outstanding structure in the town.

dropped to 26,000. In recent years three integrated mining and concentrating plants have dominated the scene and further loss in population has been experienced.

The local interest in mining is further reflected by widespread public interest in world prices of silver, lead, and zinc. Elsewhere in Australia the market prices of wool and wheat provide topics for conversation. Broken Hill newspapers present detailed mining news in contrast to the emphasis on agricultural news in other centers of corresponding size. A small flour mill, cold storage and ice plant, wood-working establishment, gas works, and soft drink factory comprise the few industries in Broken Hill not directly related to mining.

The prevalence of Adelaide newspapers in Broken Hill rather than Sydney papers reflects clearly the direction in which the mining community looks toward the seaboard. It should be noted that Sydney was connected by rail with Broken Hill only in 1927. Nevertheless, it is the exception in Australia to find a community of size in one State looking to the capital of another State as its principal commercial outlet. It is surprising that Sydney should have waited forty years after Broken Hill began pouring out its wealth before securing a direct railroad connection.

A larger proportion of non-British residents is to be found in Broken Hill than in most Australian towns and cities. The large number of unmarried men living in small hotels and rooming houses reflects the transient nature of a considerable proportion of its population. The frequency of labor troubles throughout the years of mining at Broken Hill suggests some of the difficulties of stabilizing a population originally composed of individualistic prospectors and adventurers. Transportation within the town is dependent upon inadequate bus service, antiquated private automobiles, and large numbers of bicycles. A disproportionately large share of men in the population of Broken Hill further reflects its strictly industrial character and likewise its unattractive residential qualities. Higher food costs than in large coastal cities are accounted for by the unproductive character of the surrounding area. Fresh milk, vegetables, fruits and many other foodstuffs are brought daily from Adelaide.

URBAN TRAITS OF PORT PIRIE

Port Pirie, with a population of 10,000, is located on the flat eastern shore and near the head of Spencer's Gulf (Fig. 3). Its immediate site was determined by an indentation in the shore line and by the abandoned but navigable mouth of the River Broughton, now known as Port Pirie Creek. The fringe of the delta-fan is a marshy waste over a belt several miles in width and it is within that zone that the town has been developed. The surface rises gradually to the east as Flinder's Range is approached. The general situation of Port Pirie is much like that of Port Adelaide at the mouth of the Torrens River, 150 miles to the south.

Port Pirie began as one of several small wheat exporting ports serving the excellent wheat land on the fertile and well drained soils stretching north of Adelaide between Flinder's Range and Spencer's Gulf. With the development of Broken Hill as a mining center it became the logical terminal for handling the export of bullion and silver-lead concentrates and the import of fuel, timber, and mining equipment. Later, as has been shown, it became the principal center for silver and lead smelting and refining in the Commonwealth.

The smelting plant is the dominant feature in the town and its 250-foot chimney stacks spread a pall of smoke over the town and bordering lowland (Fig. 12). The compact plant is situated on the west side of the estuary and about two miles upstream. The channel has been dredged and larger vessels are able to enter at high tide. A half mile of waterfront is developed to serve the needs of the refinery. Coke, zinc concentrates, lead bullion, and fluxing materials are efficiently handled (Fig. 13). Water for cooling purposes is pumped from the estuary. Another half mile of the

FIG. 12.—The large smelting plant at Port Pirie as viewed from the waterfront. The air is filled with smoke and fumes from the smelter.

FIG. 13.—Ore materials on refinery wharf at Port Pirie. Coal handling cranes and general cargo docks along the waterfront in the distance.

waterfront south of the refinery is devoted to the handling of general cargo, coal, lumber, and wheat. Steam and electric cranes as well as large numbers of horses are used in moving the bulky cargoes which characterize the

port. Still farther upstream numerous small fishing and pleasure boats find anchorage.

The principal commercial street parallels the waterfront and terminates at the main gate of the refinery. The stub-end railway serving the refinery and the port enters the town via the main street which resounds with the rattle of railway trucks and locomotives. The principal public buildings such as the Customs House, Town Hall (1884), Court House, Post Office, Railway Station, and Library are grouped in a single block beside the principal wharf and near the smelting works. The commercial establishments and workingmen's residences are similar to those in Broken Hill (Fig. 14).

FIG. 14.—A portion of the commercial district in Port Pirie. Note the verandah-covered sidewalks and numerous bicycles.

The residential areas spread out to the south and southwest of the refinery over the low plain (Fig. 15). The better homes, built of native brown stone, are situated on slightly higher ground in the southwest corner and farthest removed from the smelting works.

A low earth embankment along the harbor front to the east and a higher one to the north and west protect the town from the encroachment of sea water which during times of continued southwest winds has been piled up at the head of Spencer's Gulf and formerly inundated portions of the town.

FIG. 15.—Workmen's homes in Port Pirie. Sheet iron roofs and walls are characteristic, and wooden fences border the barren streets.

Following heavy rains the town has been flooded also by water moving down the gentle fan slope from the Flinder's Range. A more suitable site for the town several miles to the north where higher ground is available in close proximity to navigable water seems to have been overlooked. Great piles of black granulated slag cover large areas behind the refinery where it is being held for future treatment to recover its zinc content. The dull green marsh more or less encloses the entire settlement, the future of which will be largely co-extensive with that of Broken Hill.

In recent years the plant has employed only about 1,300 men, while at times in the past the number has been about 3,000. The considerable numbers of Greeks engaged in restaurants, fruit stores and refreshment parlors and the predominance of Italians among fishermen provides a contrast to the predominantly British refinery employees. During past years when the smelters were more active, large numbers of "foreigners" were employed in the refinery plant.

A MAJOR FACTOR IN AUSTRALIAN DEVELOPMENT

The Broken Hill mineral deposit has not only contributed greatly to the wealth of Australia, but it has created towns, industries, transportation facilities, and market centers in an arid interior lacking other bases for such

development. The gradual exhaustion of the mineral reserve, however, gives ample warning of the ultimate necessity of abandoning many expensive improvements and of the enforced reorientation of large numbers of persons in other employment in new locations. Broken Hill functions only in a small way as a market center for the sparse pastoral industry of the district.

The products of Broken Hill have comprised an important share of Australia's mineral exports which, along with agriculturel exports, form the bases of extensive world commercial relationships. The establishment of industries in several states of the Commonwealth based upon the preparation and use of Broken Hill minerals has helped to bring about a more equitable balance between primary and secondary production as well as to bring about a greater degree of national economic unity. Such industries also have notably assisted the States toward a co-operative and beneficial program of resource utilization. Thus the influence of "the broken hill" has been of major order in Australia and its ultimate exhaustion will be a matter of more than local consequence.

University of California at Los Angeles.
October, 1939.

A Second Epoch of Destructive Occupance in the Driftless Hill Land[1]

(1760-1832: Period of British, Spanish and Early American Control)

GLENN T. TREWARTHA

During the nearly three quarters of a century following termination of French control over the Upper Mississippi Country, destructive exploitation of such natural resources as furs and minerals continued to be the almost exclusive concern of white men coming to the Driftless Cuestaform Hill Land (Fig. 1).[2] Such a robber economy had prevailed for more than seventy-five years under an earlier French regime, but its development was further intensified under the subsequent British, Spanish, and early American sovereignties. Not until after the Black Hawk War of 1832, and the final canceling of the Indian title to the lands east and west of the

[1] Three earlier papers by the author dealing with settlement in the Driftless Hill Land are:

"French Settlement in the Driftless Hill Land," *Annals of the Association of American Geographers*, XXVIII (1938), pp. 179–200.

"The Prairie du Chien Terrace: Geography of a Confluence Site," *Ibid.*, XXII (1932), pp. 119–158.

"The Earliest Map of Galena, Illinois," *The Wisconsin Magazine of History*, XXIII (1939), pp. 40–43.

Aid in completing this study has been received from research assistants subsidized by the University of Wisconsin.

[2] The region here designated as the Driftless Cuestaform Hill Land refers to that part of the inner basin of the Upper Mississippi unmantled by recent till sheets, where the local relief usually exceeds 250 feet. It is not identical with the well known Driftless Area, although in general that region forms its innermost and roughest parts. Relatively inconspicuous deposits of old till cover extensive areas on its western and northern margins. Low hill country or rough plain are the most suitable descriptive terms for the region. Excepting a few sectors, its circumference is defined by the belt enclosed between the local relief isarithms of 200 and 300 feet. Over considerable areas local relief exceeds 500 feet and at a maximum reaches 800. See paper on "French Settlement in the Driftless Hill Land," referred to in footnote 1, Figures 1 and 2, pp. 180 and 181, for maps showing relief boundaries and glacial margins of the region.

FIG. 1.—The Driftless Hill Land is not co-extensive with the well-known Driftless Area. In northeastern Iowa, southeastern Minnesota, and northwestern Wisconsin thin and relatively inconspicuous mantles of old drift occupy portions of the Driftless Hill Land. The diggings indicated were those worked by Indians as of about 1820 and described on page 123.

Mississippi in the southern part of the region, did agricultural settlers arrive in considerable numbers. Their invasion, and the resulting modifications of the land surface, are taken as terminating the one period and inaugurating the other.

Unlike French exploitation, that which followed did not produce the riverine stockaded and garrisoned fur trading post as the characteristic unit of settlement. Numerous small independent traders buying furs directly from the Indians at the latters' villages, or more commonly at points of rendezvous, was the substituted procedure. After the turn of the nineteenth century a tendency toward monopolistic organization in the form of large trading companies became more evident. It was during the period under consideration that the heyday of the fur trade was reached and its serious decline begun. Exploitation of lead, on the other hand, beginning somewhat later and developing much more slowly, had nowhere near reached its peak when the flood of agricultural settlers began to arrive.

1. PERIOD TO THE CLOSE OF THE REVOLUTIONARY WAR

TRADE: ROUTES, COMMODITIES, AND CARRIERS

Within the Driftless Hill Land termination of the colonial war between France and Great Britain resulted in a rapid revival in fur trading operations. French and French-Canadian traders once more headed their canoes for the northwest, while British traders who had long looked with covetous eyes upon the rich fur trade of the Upper Mississippi and Great Lakes now hastened into the West in large numbers. The importance of the Driftless Hill Land in this trade revival is attested to by the fact that of the 121 licensed trading canoes loaded with Indian goods sent to the Northwest in 1767, sixty went via La Baye (Green Bay), most of them no doubt destined for the Upper Mississippi.[3] At the same time numerous traders carrying Spanish licenses were coming upstream from Louisiana and the Illinois country and carrying on operations on the western side of the river. Carver complains bitterly of the efforts of Frenchmen residing west of the Mississippi in Spanish territory to divert the Indian trade away from the British and toward Louisiana.[4] The bulk of the region's trade, however, probably fell to the British. Thus, conditioned both by locations of the commercial headquarters of competing sovereignties, and by connecting routes of travel with these centers, there developed open competing markets, served by contrasting routes, for the Indian trade of the Driftless Hill

[3] Louise Phelps Kellogg, *The British Régime in Wisconsin and the Northwest*, p. 47. State Hist. Soc. of Wisconsin, Madison, 1935.

[4] *Carver Manuscripts* (Minnesota Historical Society, St. Paul).

Land. An east-west flow of goods, perhaps the larger, moved along the Fox-Wisconsin portage route to and from British colonial ports on the Great Lakes and the St. Lawrence. The other line of traffic followed the Mississippi and led to the Spanish settlements in Louisiana and to St. Louis. Jonathan Carver, who traded on the Upper Mississippi, with headquarters at Prairie du Chien, records that the Indians congregated at that place and there determined by council whether it was to their interest to "dispose of the products of the chase at this place, *or to transport them to Mackinaw on the one hand, or to Louisiana on the other.*"[5]

A still more detailed account of the quantity, composition, and routes of Driftless Hill Land trade just prior to the Revolutionary War is furnished by Peter Pond, a Connecticut trader, who likewise had headquarters at Prairie du Chien. Concerning the latter settlement he writes: "Here the Botes from New Orleans Cum. They are navagated By thirtey Six men who row as maney oarse. They Bring in a Boate Sixty Hogseats of Wine on one xxxx Besides Ham, Chese &c—all to trade with the french and Indians. Thay Cum up the River Eight Hundred Leages."

". . . Thare was Not Les than One Hundred and thirtey Canoes which Came from Mackinaw Caring from Sixtey to Eightey Hundred wate Apease all Made of Birch Bark and white Seder for the Ribs. Those Boates from Orleans and Ilenoa and Other Parts ware Numeres. xxx The Number of Packs of Peltrey of Different Sorts was Cald Fifteen Hundred of a Hundred wt Each which went to Makana (Mackinac)."[6] This statement that 150,000 pounds of peltry left Prairie du Chien for Mackinac in the spring of 1774 is one of the very few reliable statements concerning the magnitude of the Upper Mississippi fur trade. Pond makes no comparable statement concerning fur shipments southward but we may assume that they were smaller. However, since the active mines were on the western or Spanish side of the river, practically all of the lead cargo moved down the Mississippi. No record is extant concerning the magnitude of shipments of lead during this period.

Pond's quoted comments make clear the contrast in the nature of the carriers on the two competing water routes. On the Fox-Wisconsin route, where the rivers were shallower and a portage was necessary, numerous light canoes were used, while Mississippi traffic employed fewer, but much larger, rowed boats. From the few items of cargo mentioned as being brought by the boats from the south it may be assumed that bulkier goods, especially foodstuffs, came on the larger carriers from the agricultural country of Louisiana and Illinois. On the other hand provisions were less easily

[5] *Wisconsin Historical Collections,* VI, p. 226. Madison (Wis.).
[6] *Ibid.,* XVIII, pp. 339–341.

produced in the region tributary to the northeastern route, and in addition lighter more compact manufactured wares were better suited to canoe transport.

SETTLEMENTS

As indicated earlier, under English and Spanish control fur trading operations were carried on by methods that required no such semi-permanent posts or establishments as were typical of the French period. Trading was less under the direct supervision and control of government officials, civil and military. Perhaps the growing dependence of the Indians upon the white man's goods made them less hostile, so that there was not the same need for traders to go in groups under military protection. But whatever may have been the reason, the independent small trader engaging in free competition with others of his kind, became the rule. Under such a system of trading the need for permanent white settlements was not urgent. The traders usually did not remain long in one place and much of the time they and their goods were in transit.

From fragmentary evidence, part of it circumstantial, it appears likely that there were two small nuclei of white settlers within the Driftless Hill Land during and preceding the Revolutionary War. One was at the mouth of the Wisconsin, at what was even then known as Prairie du Chien, while the other was situated west of the river in the lead mining region, approximately where Dubuque, Iowa, now stands.

Prairie du Chien—a Commercial and Military Settlement[7]

The early strategic character of the Mississippi terminus of the Fox-Wisconsin portage route is evidenced by the one or more French posts that were located there. Peter Scanlan, the local historian of Prairie du Chien, is of the opinion that even before the close of the French period there was at least one white family resident upon the Prairie du Chien terrace.[8] Other French-Canadians similarly engaged in hunting, trapping, and trading may well have been there at the time of the trade revival following upon the establishment of peace and the transfer of the French territory to Britain. Coincident with this reestablishment of trade, Prairie du Chien assumed the position of the most important collecting, distributing, and *entrepôt* center for commerce between whites and Indians on the Upper Mississippi. Jonathan Carver and Peter Pond, travelers and

[7] Although Prairie du Chien was the outstanding settlement on the Upper Mississippi, because of its detailed treatment in an earlier paper (reference in footnote 1), it will receive slight comment here.

[8] Peter Lawrence Scanlan, *Prairie du Chien: French, British, American*, pp. 52–53. Menasha (Wis.), 1937.

traders on the Upper Mississippi, have left valuable eyewitness accounts of Prairie du Chien's greatness as a trading center.[9] Carver comments as well upon the natural beauties of the grass-covered Prairie du Chien terrace, and upon the large Indian village there with its associated agricultural developments. No mention is made by either Carver or Pond, however, of a permanent white settlement. But as Kellogg points out, they were not so much interested in the white residents and may have had no contact with them. It is believed, however, that a few French families may have been residing on the terrace at the time.[10] Carver mentions the name of one resident Frenchman whom the Indians there used as interpreter.[11] In fact even during the Revolutionary War, when trade activity slackened, a number of traders still claimed Prairie du Chien as their residence.[12] It would seem strange indeed if this site, which at least twice a year became the great meeting place of hundreds of traders and Indians, did not by its functional development and associated service requirements attract permanent residents as well. However that may be, the uniqueness of the settlement lay in the seasonal ebb and flow of both its white and Indian populations following the movements of the fur trade. It is significant to note that at an early period the Prairie du Chien terrace became a neutral ground for the various Indian tribes and no acts of hostility were ever committed during the seasonal encampments there.

In spite of the fact that Prairie du Chien had grown to be the great fur mart of the Upper Mississippi country, and was probably the permanent residence of a number of French-Canadian and half-breed families who by crude farming methods supplied themselves and other traders with potatoes, peas, and melons, no formal claim to land ownership had been made. It was toward the close of the Revolutionary War that three French-Canadians, probably acting as the agents of other residents at Prairie du Chien, were granted possession by the Canadian government to the nine square miles of terrace just north of the mouth of the Wisconsin.[13]

Besides its function as the great center for fur trading operations on the Upper Mississippi, during the Revolutionary War the confluence settlement became of military importance as well. Special British agents were stationed at Prairie du Chien to influence the surrounding Indian tribes in the British cause. Upon certain occasions also this settlement was used as a

[9] *Wis. Hist. Colls.*, X, pp. 34–35; XVIII, pp. 339–341.

[10] Kellogg, *The British Régime in Wisconsin, cit.*, p. 70.

[11] *Carver Manuscripts, cit.*

[12] Scanlan, *op. cit.*, p. 67.

[13] *Wis. Hist. Colls.*, XI, pp. 249–250. *History of Crawford and Richland Counties, Wisconsin*, pp. 270, 276, 280. 1884.

military recruiting station for Indian auxiliary troops. Prairie du Chien likewise became the place of rendezvous and outfitting for a large British and Indian expedition against the Spanish at St. Louis and the Americans at Cahokia. A motley force of about 1200 men, consisting of a small nucleus of regulars, a larger number of traders, and their *engagés*, but the main body composed of upper-river Indians, assembled there for embarkation. To store and protect the valuable furs of the traders while they were away on the military venture, a fort was built at Prairie du Chien.

The Spanish Mines at Dubuque

The other pre-Revolutionary War settlement within the bounds of the Driftless Hill Land had its primary inception in the exploitation of mineral wealth rather than trading in furs. As early as the late sixteen hundreds these lead deposits in the vicinity of Dubuque were known to the French, and Perrot's fort near present-day East Dubuque probably was established for the purpose of trading with the lead-mining Indians. The period of the first actual working of the deposits by white settlers is not known. When Julien Dubuque came in 1788 he found traces of former white occupance chiefly in the form of substantial roads built for the transportation of ore.[14] From Father Mazzuchelli's diary we learn the names of two white men who supervised the exploitation of the Dubuque mines before the coming of Julien Dubuque.[15] Considering the fact that the location of these ore deposits had been so well advertised for three quarters of a century, it is difficult to believe that traders on the Upper Mississippi had not endeavored to exploit them before 1788, when Dubuque arrived. Of how continuously the mines were worked, by how many persons, and what settlement features were established on the site, there is no record. However, when during the Revolutionary War an expedition of British and Indians from Prairie du Chien surprised and captured the Spanish mines at Dubuque, a number of Spanish and Americans were captured and 50 tons of lead secured.[16] That there were at least 17 men at the mining settlement is a certainty, for that number arrived as prisoners at Michilimackinac. There may have been others who escaped. By this episode the fact is established beyond possibility of contradiction that a mining settlement did exist during the Revolutionary War period on about the site of present-day Du-

[14] *Wis. Hist. Colls.*, XIII, p. 279.

[15] Memoirs of Father Mazzuchelli (1915), p. 163. Quoted in M. M. Hoffman, *Antique Dubuque, 1673–1833*, pp. 52–53. Dubuque (Iowa), 1930.

[16] Letters from Lt. Gov. Sinclair at Michilimackinac to Gov. Gen. Haldimand. Quoted in *Wis. Hist. Colls.*, XI, p. 151. See also, Hoffman, *op. cit.*, pp. 67–69.

buque. Lead from the Dubuque mines moved down-river toward the Spanish and American settlements and some of it no doubt was processed into bullets to be used against the common enemy, the British.

2. POST REVOLUTIONARY WAR PERIOD

The Driftless Hill Land was little if any affected by the transfer of sovereignty of lands east of the Mississippi from England to the United States. An Indian country the region still remained and the few white men who came into the region were attracted either by furs or lead. For a few decades at least trade in pelts continued to increase. Just prior to the turn of the century one prominent trader computed the annual number of packs of pelts sent to Mackinac from the Mississippi region to be 3216, valued at £15 per pack.[17] For 15 years prior to 1804 the value of the furs sent annually to St. Louis was estimated to average $203,000.[18] Most of the trade remained in the hands of British agents who sent their pelts down the Mississippi to St. Louis and New Orleans as well as to Canada.[19]

Lead became an increasingly important item of cargo leaving the Driftless Hill Land, and before the end of the period had become much more important than furs, while miners greatly exceeded fur traders in numbers. Lead shipments followed the southern route almost exclusively, while furs on the other hand continued to go both to Mackinac and to St. Louis.

A principal contrast between this and the preceding period is the greater detail in which the settlements stand revealed. For the pre-Revolutionary War period usually the best that can be done is to establish, often by fragmentary circumstantial evidence, the existence of settlements. No details as to forms, patterns, or internal arrangements are possible. On the map, a mark showing location is the limit of cartographic representation. For the later period fairly accurate information is available relative to size of settlements, and some knowledge is to be had concerning their morphological features.

TRADING SETTLEMENT: PRAIRIE DU CHIEN

With the decline of the fur trade after about the turn of the century, Prairie du Chien's fame as a trading center waned. Contemporaneous

[17] *Michigan Pioneer and Historical Collections*, XXV, p. 205. Compare this figure with Carver's estimate for 1774 previously quoted; see p. 112.

[18] *Abridgement of the Debates of Congress from 1789 to 1856*, vol. VII, p. 202. New York, 1858.

[19] *Ibid.*, p. 202.

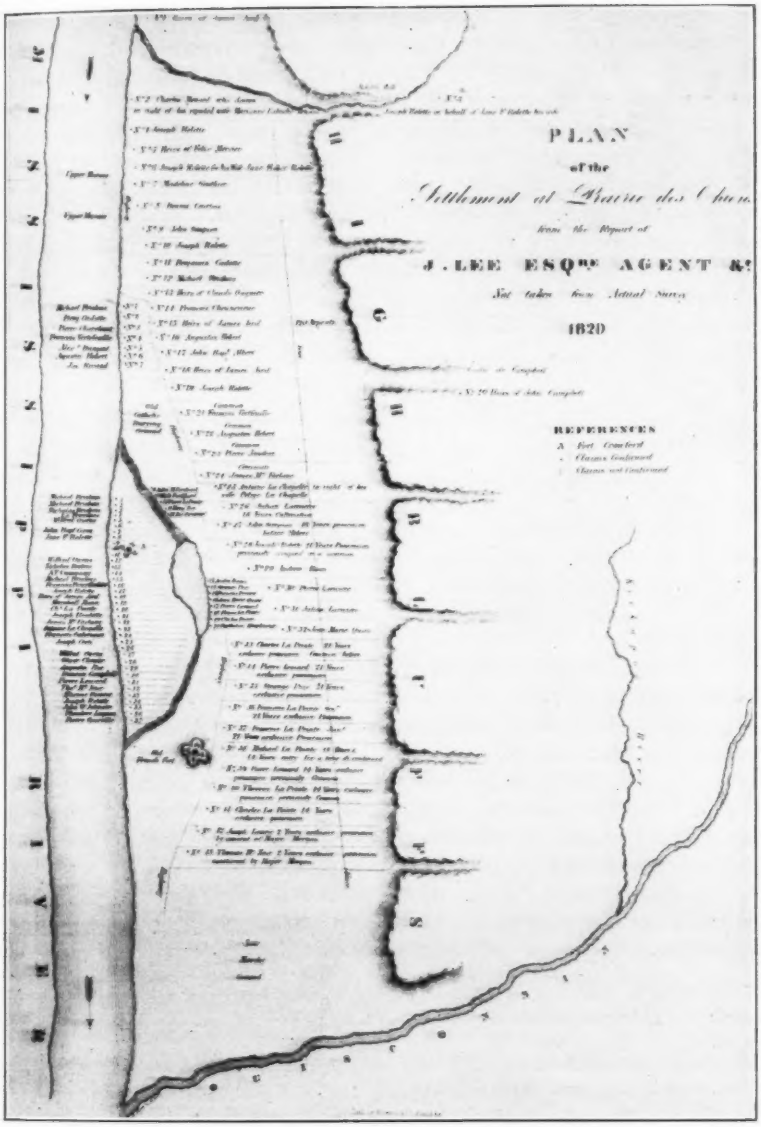


FIG. 2.—This is the earliest map of the Prairie du Chien settlement. From, *American State Papers*, Gales and Seton Edition, vol. 5, Public Lands, p. 309.

with this change came its increased importance as a military center. The geography of the town during this critical transition period is dealt with in detail in an earlier paper by the author (see footnote 1). It needs here only to be emphasized that Prairie du Chien represented a unique form of settlement for the Middle West. In the midst of a region which from the very beginning of agricultural settlement was characterized by dispersed farmsteads, here on the confluence prairie the tillers of the soil congregated in a village, as did the farmers of seventeenth century New England. Not only in the compact manner of farm residence, but likewise in the use of pasture land in common and in the cultivation of fields arranged in long parallel strips with no fences but only paths and roads defining their boundaries, did Prairie du Chien resemble the Puritan towns of Massachusetts and Connecticut. Its non-midwestern character was in part accounted for by its antiquity, by its long period of isolation far beyond the frontier, and by its relatively greater emphasis upon trade than upon agricultural pursuits (Fig. 2).

FARMING SETTLEMENT: GIRARD'S FARM

On the western side of the Mississippi almost directly opposite Prairie du Chien there was in existence for some time both before and after 1800 an agricultural settlement whose French proprietor was a resident of the confluence village.[20] Girard's claim as shown by the sketch contained in the United States land records for the state of Missouri,[21] was rectangular in shape, six miles east-west by one and a half north-south, and fronted upon the river (Fig. 3). The locations of two houses and one barn are shown on the land-office sketch, one house close to the river, and the other, together with the barn, some distance inland. No information exists concerning the number of people comprising the settlement but no doubt it was small. From the testimony of several deponents supporting Girard's claim to ownership of the land, one gleans a few fragments of significant information.[22] One stated that the land was "inhabited and cultivated by some of claimant's people," while others speak of his "hired man" and his "farmer." The terms employed indicate only a relatively small resident population. The same testimony states that there were at least 50 acres

[20] Peter L. Scanlan and Marian Scanlan, "Basil Girard and His Land Claim in Iowa," *Iowa Journal of History and Politics*, vol. 30 (1932) pp. 219–247. Iowa City, Iowa.

[21] Book C, p. 518. A certified copy of the original is to be found in *Annals of Iowa, Third Series*, vol. 16, p. 625.

[22] *American State Papers, Public Lands*, vol. II, pp. 439, 440. Duff Green's Edition, 1834.

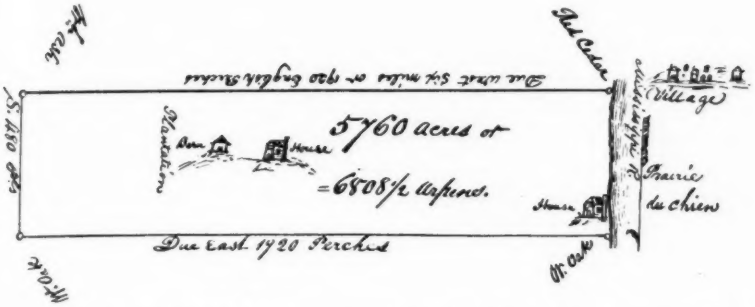


FIG. 3.—Girard's claim in Iowa, opposite Prairie du Chien. From a certified copy of the original land-office plat, in *Annals of Iowa, Third Series*, vol. 16, p. 625.

under cultivation, that corn was one of the crops, and that there was livestock on the farm. In all probability Girard's claim represented a unit of commercial agriculture under the supervision of an absentee landlord. The produce from the farm, no doubt, was sold to the villagers at Prairie du Chien, and to the traders and Indians at their spring and fall gatherings on the Prairie.

MINING SETTLEMENT

The Dubuque Mines

For more than a decade before and after the turn of the century a kind of proprietary white settlement existed in the vicinity of the present-day Dubuque, Iowa. As a result of purchase from the Fox Indians and later confirmation by the Spanish authorities[23] at St. Louis, Julien Dubuque came into possession of an estate stretching twenty-one miles along the Mississippi and having a depth of approximately nine miles (Fig. 4). The north and south limits of this grant were the mouths of the Little Maquoketa and Têtes des Morts Rivers. Dubuque's zeal for possession of this particular piece of terrain was related to its century-old fame as a lead-producing region. Active development of the claim was largely confined to the rolling upland or bench developed upon Galena dolomite, bounded by the Niagara Escarpment on the west and by the bluffs along the Mississippi on the east, for it is the Galena formation that contains the lead.

When Dubuque took up residence upon his new claim, ten white men went with him from Prairie du Chien to aid in the development of the

[23] Not recognized by the United States Supreme Court.

mines. How many more entered his services at later dates is not known, but the magnitude of Dubuque's enterprise argues for a considerable male population. In the United States Supreme Court records of the case of Chouteau *vs.* Molony it was brought out that Dubuque actually resided on his claim from 1788 to the time of his death in 1810, "that he made improvements on it, cleared an extensive farm, constructed upon it houses and a horse-mill, that he cultivated the farm."[24] Further details regarding magnitude and patterns of development are revealed in a sketch of the original plat of Dubuque's claim contained in the United States land records for the state of Missouri.[25] On this the two distinct lines of dolomite bluffs bounding the active development of mines and farms are shown. Some forty mining pits, four separate areas of cultivation, and a number of houses or other buildings belonging to the proprietor are located. Some of these no doubt are stables; others were warehouses for storing pelts and lead ore, or cabins for his French and half-breed foremen and workers. The lead smelting furnaces were probably the largest in the West.[26] An early traveler referred to Dubuque's estate as a fortified settlement, so it seems likely that in addition to having a cannon, it may have been protected by log palisades. The sight must have been an impressive one.

Although mining operations, in all probability, were most intensively developed within the boundaries of the claim, Dubuque does not seem to have restricted his operations to the Spanish side of the river. There are good reasons for believing that his prospectors and miners opened leads east of the river in what is now northwestern Illinois and southwestern Wisconsin.[27] The only competition in that region was from representatives of the American Fur Company who obtained Indian-smelted lead from the Fox tribes. It appears that Dubuque made use of his Indian friends in prospecting for lead mines, but that he sent his Canadian and half-breed workers to prove reports of lead and sometimes to work the mines as well. Frequently, however, he was content to allow the Indians to work the proved claims, since eventually the product found its way into his smelters and large trading house on the west side of the river.[28] Thus before there was any permanent white settlement in the lead areas east of the river, that

[24] *U. S. Supreme Court Reports, Howard,* vol. 16, pp. 221–222.

[25] A certified copy of the original plat is to be found in *Annals of Iowa, Third Series,* vol. V, p. 328. Book B, p. 81.

[26] Hoffman, *op. cit.,* p. 94.

[27] *Ibid.,* p. 87; R. G. Thwaites, "Notes on Early Lead Mining in the Fever (or Galena) River Region," *Wis. Hist. Colls.* XIII, pp. 271–292 (279–283); Joseph Schafer, "The Wisconsin Lead Region," *Wisconsin Domesday Book, General Studies.* III, pp. 33–34. Wis. State Historical Society, Madison, 1932.

[28] Thwaites, *op. cit.,* p. 282.

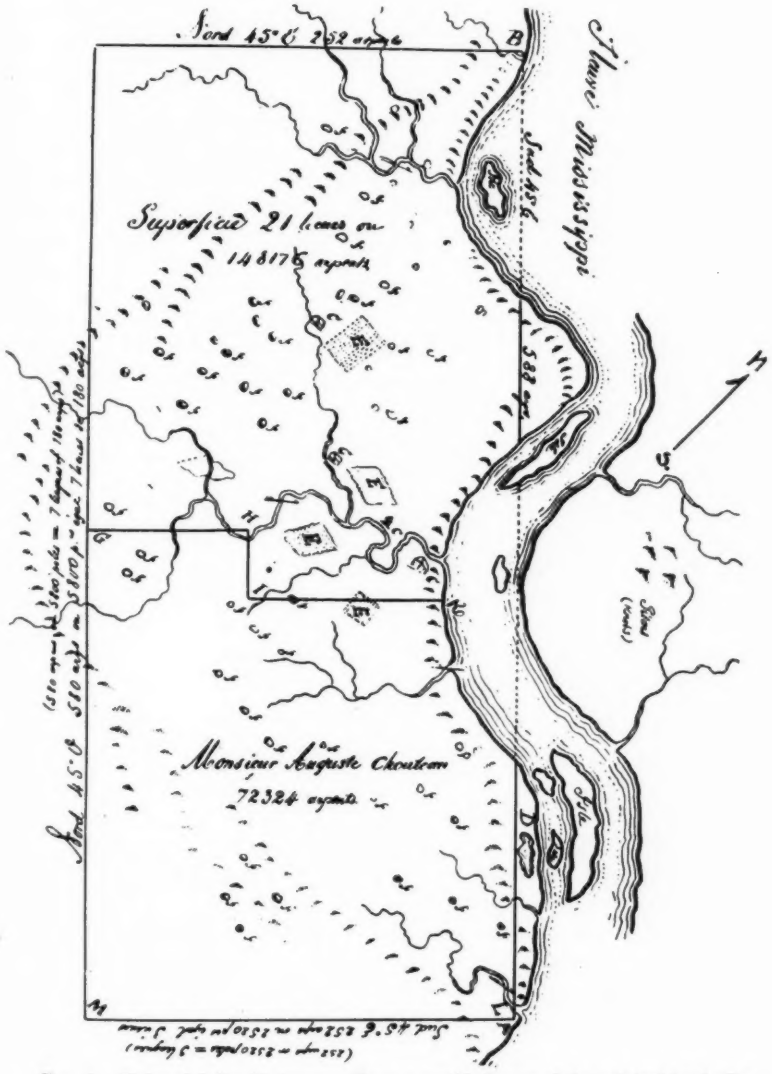


FIG. 4.—Claim of Julien Dubuque. From a certified copy of the original land-office plat in *Annals of Iowa, Third Series,* vol. 5, p. 329.

district had been brought within the sphere of Dubuque's lead mining operations and was in a sense occupied by his workers. Twice a year Dubuque's boats went to St. Louis loaded with lead ore and furs and brought back to his wilderness settlement merchandise for the Indian trade. He became supreme in the lead trade of the west. "He controlled the boats which carried the product down the river to market. In gaining absolute supremacy over the lead industry he displayed remarkable talent. For whatever lead ores he purchased, he established the rate. In the market he fixed the price of the required product. By a hundred and twenty-five years he anticipated the policies of the Guggenheims and the American Smelting and Refining Company."[29] No statistics regarding the quantity of Dubuque's transactions in lead exist, but the year after his death the Indians at the Dubuque mines sold 500,000 pounds of lead to traders.[30]

There is much more information concerning Dubuque and his settlement as related to mining than there is in their associations with the fur trade. No doubt exists however that Dubuque was one of the greatest traders of the Upper Mississippi valley and his establishment on that river was a principal center of fur trading operations. The heyday of the fur trade was probably reached during his two decades of occupance at "The Spanish Mines," and he made the most of his strong influence among the Indians to exploit the trade in furs to the limit. A Frenchman sent by Napoleon in about 1800 to inventory the resources of Louisiana, estimated the value of the furs taken on the Upper Mississippi at that time to be 1,200,000 *livres tournois* ($240,000 in that period).[31]

How long the white settlement at the Spanish Mines persisted after Dubuque's death is not known, but the beginning of the War of 1812 seems to mark its termination. Schoolcraft and other writers of that day indicate that the Fox Indians burned the houses and fences and tried to destroy all evidences of white mining in order to discourage Americans from attempting further settlement. The general hostility of the Fox Indians successfully prevented the reestablishment of permanent white occupance at the mines until after the Black Hawk Purchase (1833), at which time the region was thrown open to agricultural settlers. During this interim period there were a number of abortive attempts by whites to occupy the mines and at times as many as 100 men were living in the region. But all of these intrusions were quickly frustrated, either by the Indians them-

[29] Charles R. Keyes, "Spanish Mines: An Episode in Primitive American Lead Mining," *Annals of Iowa*, vol. X, pp. 539–546 (546).

[30] H. M. Brackenridge, *Views of Louisiana*, p. 65. Pittsburgh, 1814.

[31] *Abridgement of the Debates of Congress from 1789 to 1856*, vol. VII, p. 202.

selves, or later by the American government, which respected the Indian title to the lands.

Some sort of mining operations continued to be carried on by the Fox Indians, who sold their ore to traders located on islands in the Mississippi opposite Dubuque's claim where smelting furnaces had been constructed. In 1823 two traders located on such an island shipped 100,000 pounds of lead.[32] Other traders located along the east bank of the river opposite the mines and bartered for lead. Thus, while no actual white settlement existed on Dubuque's claim after his death, its mineral wealth continued to keep a few whites on its periphery.

Fever River and Other Lead-Mining Settlements East of the Mississippi

In all probability it was only after the French had introduced firearms among the Indians that lead became an item of genuine usefulness and trading value in the eyes of the natives. Some knowledge concerning Indian sources of lead along Fever River, in what is now northwestern Illinois, became current not only in North America, but in Europe as well, not long after Frenchmen reached the Upper Mississippi.[33] But in spite of this acquaintance with the fact of mineral potentialities in what is now the three southwestern counties of Wisconsin and Jo Daviess County in northwestern Illinois, no permanent mining communities developed in this area until the beginning of the third decade of the 19th century, just preceding the influx of agricultural settlers. In part this late development may be explained as due to the hostility of the Indians toward white men seeking to exploit their mines. As indicated earlier, some of Dubuque's men probably collaborated with the resident Indians in opening up mines in the Wisconsin-Illinois lead area prior to 1800, but this work resulted in no white settlements.

In comparison with the other units of white settlement in the Driftless Hill Land previously described, this one east of the Mississippi and south of the Wisconsin was much more extensive. Moreover it was composed

[32] Hoffman, *op. cit.*, p. 156.

[33] Hennepin's map of 1687 shows a lead mine in the vicinity of Fever River. Penicaut, the scribe of Le Sueur's expedition (1700), refers to a mine up the "Rivière de la Mine" or Fever River, while William de l'Isle's chart of Louisiana (1703) located the lead mining areas of Dubuque and Fever River. Le Guis visited the mines on Fever River in 1743, and noticed that there were 18 to 20 men at work and that they had extracted 150,000 pounds of lead in each of the two years previous. Carver's map of his travels in 1766 located a lead mine near Blue Mounds just south of the Wisconsin River. See *Wis. Hist. Colls.*, XIII, pp. 271–277; and, B. H. Shockel, "Settlement and Development of Jo Daviess County," *Illinois State Geological Survey, Bull. 26*, pp. 173–228 (179–180). Urbana, 1916.

not of one but of numerous widely dispersed nuclei. Instead of a settlement it was settlement *area*. To be sure in the beginning, Galena, the river-port gateway town, became the single important focus, and other settlements were satellite in character. For several decades Galena continued to be the most important business and commercial center, but gradually its position became relatively less important as other mining hamlets located on railroads waxed in population as the tide of agricultural immigrants poured in.

A Trader's Village on Fever River: the Beginnings of White Settlement

At the opening of the third decade of the 19th century the extraction of lead in the mining area east of the Mississippi was almost, if not entirely, in the hands of Indians. At least four separate diggings areas are known to have existed on the Illinois side and there were two others west of the River (Fig. 1). First there were the diggings on Fever River, situated some six miles or more above its mouth and on both sides of the river. A second was fifteen miles up Apple River, a smaller branch of the Mississippi a few miles south of Fever River. Here good lead was available two to four feet below the surface and canoes were able to ascend to the mine to carry it away. A third group of diggings was located four or five miles up Sinsinawa Creek, a few miles north of Fever River. Here the ore was good, but its shipment difficult, for only the smallest canoes could reach the mines. Nine miles up an unnavigable, small creek (Mechant Hatche) located some six miles above the Little Macouttely but on the opposite side of the Mississippi was a fourth lead mine.[34] Others were reported along the Wisconsin river. West of the Mississippi, in addition to the Dubuque mines, there were lead diggings about six miles up Little Macouttely Creek some fifteen miles above Dubuque's site.

Because of the assured profits to be obtained from the sale of lead, many of the Indians in this mining area had abandoned hunting and trapping in favor of mining. For a number of years itinerant traders had visited the area and exchanged their merchandise for lead, but the general hostility of the Indians towards whites showing an undue interest in their mines successfully prevented permanent settlements. One or two traders are said to have lost their lives in attempting to traffic with the lead-mining Indians. As far as is known, only at the Fever River mines, prior to 1823, were there any traders in residence and these were mostly squaw men who were trusted by the natives because of their having married Indian women. Somewhere on or near the present site of Galena were the combination residences and stores of four or five such traders.[35] An old "Gazetteer of Illinois and

[34] *Wis. Hist. Colls.*, VI, pp. 194–195.
[35] *Wis. Hist. Colls.*, XIII, p. 288.

Missouri" published in 1822 speaks of a "Traders' Village" consisting of ten to twelve cabins being located some six miles up Bean (Fever) River.[36] Dotting the bottom and adjacent slopes in the vicinity of the traders' cabins were the dwellings of 500 to 2000 Sac and Fox Indians whose trade the white men sought. Some lead smelting as well as trading probably was carried on by one or more of the squaw men on Fever River, but there is doubt as to whether any were engaged in actual mining operations. They were chiefly interested in bartering for lead and shipping it either to New Orleans or to Canada.[37] Whether or not the traders even considered the Fever River location their permanent residence is not known, but their scattered cabins at least mark the beginnings of the first white settlement within the Wisconsin-Illinois mining area.

Most of the Indian's lead went down-river to St. Louis and New Orleans and thence to New York, although some purchased by French-Canadian traders followed the Fox-Wisconsin route to Canada.[38] The down-river cargo moved in keel boats which were scowbarges fifty to eighty feet long, ten to fifteen feet wide, and two to three in draft. A cargo box extending to within ten feet of either end and two feet of the sides was built on top of the deck. The rudder was a gigantic sweep. Oars, sails, and poles were employed in propelling the boat and when it was close to the bank members of the crew seized bushes or limbs of trees and "bushwhacked" along.[39]

Population

White settlements based almost exclusively on mining were a product of the third decade of the century. During the fourth decade agricultural settlers seriously diluted the mining population. The statistics relative to the increase in number of white settlers during this mining decade are difficult to obtain and evaluate. In part this is due to conflicting estimates, which in turn may have resulted from the migratory character of the population. Many came to the mines in spring and summer only to return to their homes down-river as winter approached. It was this migratory habit, like that of the fish by the same name, that gained for these settlers from southern Illinois the name "suckers." About thirty persons are said to have passed the winter of 1822 to 1823 at the Fever River settlement.[40] A

[36] *The History of Jo Daviess County, Illinois*, p. 228. Chicago, 1878.
[37] *Ibid.*, p. 228.
[38] *History of Grant County, Wisconsin*, p. 401. Chicago, 1881.
[39] *Ibid.*, p. 400.
[40] *Wis. Hist. Colls.*, VI, p. 275.

private census taken the following summer (1823) found the number to be seventy-four.[41] Some of these were negro slaves. Since the settlement on Fever River was at that time the only one south of the Wisconsin River, this figure of seventy-four may be taken as the total white population within the entire lead region east of the Mississippi.

The period prior to 1826 was somewhat exploratory in character during which a few prospectors from Fever River spread out northward testing new sections for their lead potentialities. During these years population did not increase rapidly and it was not until about 1826, after the news concerning good prospective diggings over an extensive area had penetrated down-river, that there was a marked surge of miners into the area. By the latter part of the decade the total number of white settlers within the Wisconsin-Illinois lead region was estimated to be 10,000.[42] Estimates for the population of the mining region by individual years are as follows:[43]

1822	20	1826	1,000
1823	74	1827	4,000
1824	100	1828	10,000
1825	200		

Many of the newcomers remained at Galena only long enough to obtain what provisions and equipment were required before moving on into newer and less congested territory farther north. Thus in 1830 Jo Daviess County, in which the Galena (Fever River) settlement was located, contained only twenty-one per cent of the estimated population of the entire lead area.[44] Lacking information to show accurately and in detail the distribution of population in the lead region, a rough idea of its boundaries and of the whereabouts of its settlers may be had from Chandler's map of 1829 on which villages, diggings, and furnaces are shown (Fig. 5).

The principal source region for this immigration was the South, more specifically southern Illinois, Missouri, and Tennessee, followed by Indiana and Ohio.[45] Strong southern influence in the Galena region is indicated by the fact that Jo Daviess County adopted a southern county commissioner form of government rather than the New England township type of organization. Moreover, negro slaves were relatively numerous in the

[41] *Ibid.*, p. 280.

[42] *History of Jo Daviess County, cit.*, p. 247; Schockel, *op. cit.*, footnote 53, p. 185.

[43] Taken from figures on the margins of Chandler's map. See *Wis. Hist. Colls.*, VIII, p. 251.

[44] Schockel, *op. cit.*, p. 185.

[45] *Galena Advertiser*, Feb. 28, 1835; Schockel, *op. cit.*, pp. 186–187; Schafer, *op. cit.*, pp. 44–47.

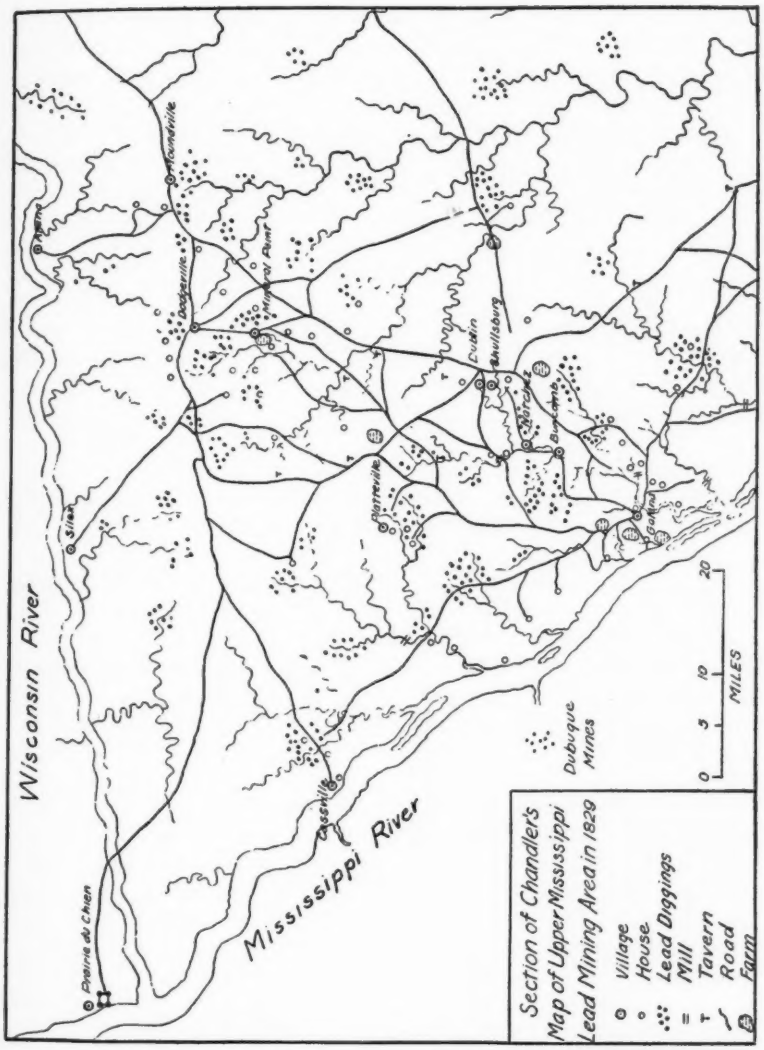


FIG. 5.—Redrawn and modified from "Map of the United States Lead Mines on the Upper Mississippi River," by R. W. Chandler of Galena, Illinois; Cincinnati, 1829. Copy in Wisconsin Historical Library.

Fever River settlement. Southern elements of architecture are still evident in the graceful porticoes and white columns of some present-day Galena homes. Reasons for this preponderance of southern men and influence among the early immigrants are not difficult to discover. The only possible source regions for settlers were the relatively populous states to the East and South. With the former, however, there was no direct and easy connection. Not even a trail connected Galena with Lake Michigan. The long developed and principal natural route was the Mississippi and by that route by far the largest numbers came. At first it was on slow-moving keel boats but later in the decade steamboats made regular trips between St. Louis and Galena. The only overland trail was likewise to the south, connecting with Peoria, the nearest large settlement 170 miles distant.[46] Over this latter route, called Kellogg's Trail, livestock were brought to the Upper Mississippi mining settlements from the agricultural settlements farther south.

Galena

As indicated earlier, the first white settlers at the site of Galena on Fever River were attracted by the trading possibilities afforded by the large Sac-Fox village located there, whose people were engaged in mining lead on the adjacent slopes and in the ravines. Thus the earliest traders' village consisted of a few cabins located in the midst of a much larger number of native dwellings. With the expansion of the traders' village into a bustling mining and commercial town, the lead mines themselves were a much more important item of fixation than the Indian village. But at the same time it was location on a river, navigable to Mississippi keel boats and steamboats, that gave Galena its principal advantage over other towns within the lead district.

Early in the summer of 1826 some fifteen log cabins and their residents comprised the Galena settlement, although by October the United States Superintendent of Lead Mines reported 548 diggers in the general Upper Mississippi lead region.[47] An arrival in June of that year speaks of looking in vain for a town or village, but seeing only a few scattered log cabins.[48] Apparently a compact arrangement was still lacking. But by November of the following year the settlement had expanded to "115 houses and stores,"[49] in July of 1828 to "195 dwellings, warehouses and shops," while forty-six buildings were commenced but not at that time finished.[50] The

[46] Schockel, *op. cit.*, pp. 188–189.
[47] *History of Jo Daviess County, cit.*, pp. 247 and 265.
[48] *Wis. Hist. Colls.*, X, p. 266.
[49] *History of Jo Daviess County, cit.*, pp. 252–253.
[50] *Ibid.*, p. 247.

number of stores and warehouses had increased to forty-two.[51] By 1829 Chandler estimated the number of houses at about 250 and the population at 800.[52] Morphology of the mushroom village was much influenced by its narrow floodplain and terrace site hemmed in between the high bluffs on one hand and the channel of the river with bordering swamps on the other. Only the meagerest written descriptions are available, however. One new arrival described the town in the summer of 1829 as follows: "This village of 200 houses is very compactly built on two streets or benches, one about 20 or 30 feet above the other, closely copying the direction of Fever River in front and a high bluff of 100 feet immediately in the rear. The Hum of business is heard on the margin of the River while abundant scope is afforded for the display of taste in the little yards and gardens which seem already to be creeping up the steep ascent of the surrounding Hills."[53] The slump in lead mining for a few years following over-production of that mineral in 1828 and 1829 resulted in a setback for the new town during the period of reduced prosperity.

By far the best information concerning the frontier town on Fever River during the first decade of its existence is furnished by an old and original map in the files of the Jo Daviess County Abstract Company of

[51] *Niles Weekly Register*, vol. 35, p. 120. The figures here quoted for number of buildings and their inhabitants by years do not agree with the following taken from *Senate Documents of the 26th Congress, 1839–1840*, vol. VI, Document 349.

GROWTH OF GALENA

1826	4	log cabins	pop.	about	50
1828	80	buildings	"	"	450
1830	80	"	"	"	300
1832	110	"	"	"	900
1837	400	"	"	"	2400
1839	550	"	"	"	3000

Because of the reasonable agreement between the reports of a number of contemporary eyewitnesses I am inclined to accept the larger estimates for number of buildings, at least for the earlier years. This requires somewhat larger population figures than are given above and this too seems to be more in line with other estimates. For example an accurate personal census taken in the summer of 1823 reported 74 persons at Galena. The migratory character of the population and the difficulty of determining what part of the larger mining population in the adjacent diggings actually belonged in the village help to explain the discrepancies in the data. The number of persons *in the vicinity* of Galena in the fall of 1826 was estimated at 550.

[52] R. W. Chandler, *Map of the United States Lead Mines on the Upper Mississippi*, notes on margins of map. Galena, 1829. Copy in Wisconsin Historical Library.

[53] Personal letter of Rev. Aratus Kent written at Galena, June 4, 1829. Photostat copy in Wisconsin Historical Library.

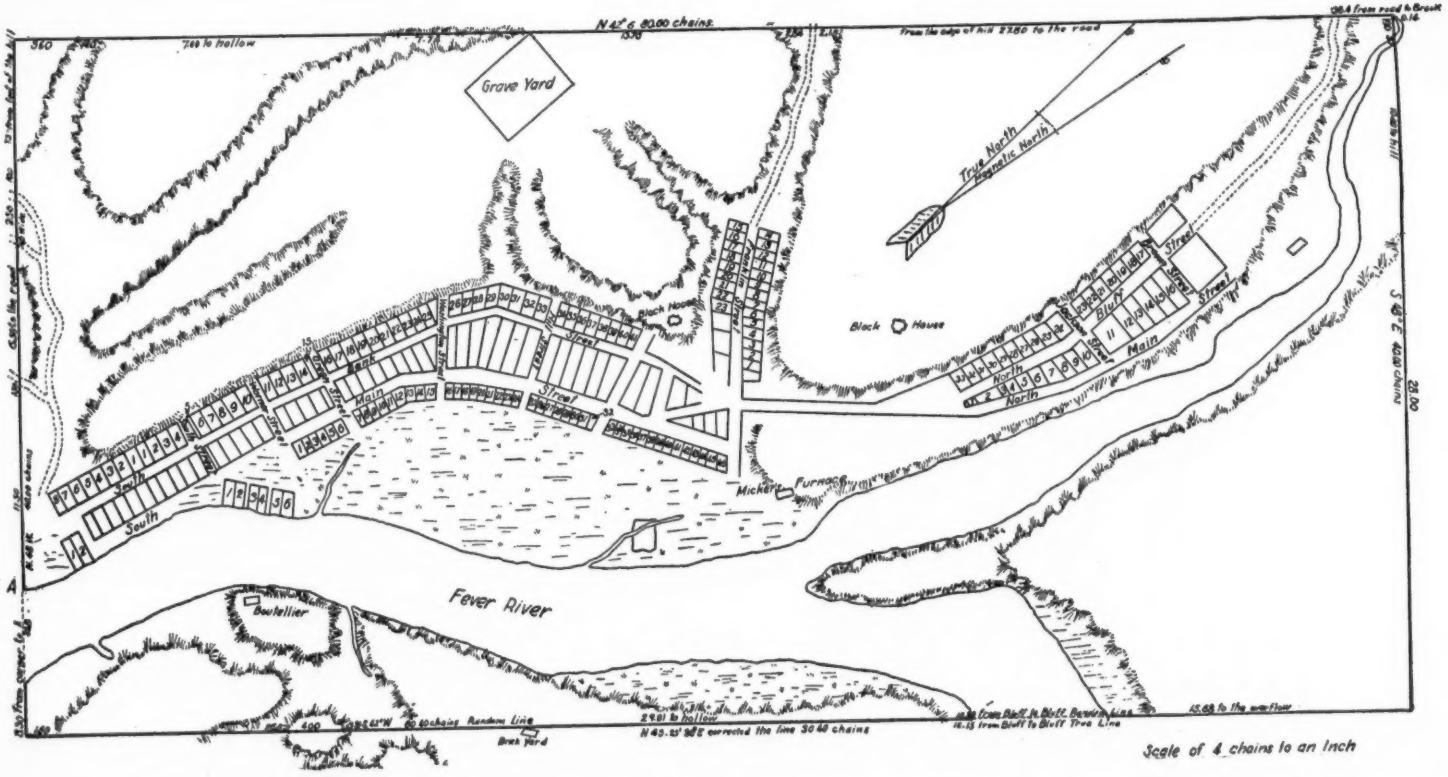
FIG. 6.—Copy of the earliest known map of the old lead mining town of Galena, Illinois. Date estimated to be about 1828. Original in possession of Jo Daviess Abstract Co., Galena. Photostat copies sent to Wisconsin Historical Library and to the National Archives, Washington, D. C. See footnote 1 for citation describing the map in greater detail.

Galena (Fig. 6). The map is undated, and no authorship is indicated, but from a number of evidences I am confident that it represents Galena as of about 1828—certainly prior to 1832. The two block houses on the bluffs just above the town probably were those erected during the Winnebago uprising of 1827.[54] "Mickers" furnace shown near the foot of Franklin Street very likely refers to the establishment of Moses Meeker noted in a report of Thomas McKnight, sub-agent of the Superintendent of United States Lead Mines, located in Galena.[55] Bouthillier, whose trading post is indicated on the map, is also mentioned in a report of sub-agent McKnight, dated 1826, as one of several from whom he had accepted bond as surety for leases of land on which to erect buildings. Charles Smith sub-agent at Galena before McKnight, states in a report dated July 25, 1826 that he had surveyed "the upper street in the town and . . . staked off the lots 50 feet, 41 in number." The map actually may have been constructed by Smith or McKnight not long after this original 1827 survey, for very clearly it is the work of a trained engineer. Since 1826 marks the beginning of a period of rapid expansion for the town, it is likely that the map represents Galena only slightly later than the date of the original survey. Certainly the well known plat of 1838 represents a town whose size and morphology are greatly different from the one shown in Figure 6.

Other than the one principal southern nucleus, occupying two streets paralleling Fever River, South Bank and South Main, there were two lesser centers of residence, also of linear or trellis pattern, lying along tributary valleys. South Bank (now Bench) Street in the main part of town occupied an alluvial terrace some 40 feet above the floodplain, while the northern center was exclusively on river terrace. The settlement as yet had not begun to expand up the slopes and on to the bluffs. A total of 159 lots are numbered on the map which may indicate that these were the ones occupied or perhaps only leased. Over 300 received permits to occupy town lots at the time of the original survey in 1826. Eight of the numbered lots at the extreme south end of town had frontage on Fever River, sug-

[54] Mrs. Adele P. Gratiot's Narrative, *Wis. Hist. Colls.*, X, pp. 261–275 (270); Costello N. Holford, *History of Grant County*, p. 16. Lancaster (Wis.), 1900.

[55] Volumes A and B, containing transactions of Lt. Martin Thomas, U. S. Supt. of Lead Mines for the years 1825–1827, formerly available at the Jo Daviess County Court House, Galena. These volumes have since disappeared. See *History of Jo Daviess County, cit.*, pp. 261, and 265–267.


Grave Yard
True North
Magnetic North
Black House
Black House
Main Street
Bluff Street
North Main Street
South Main Street
Bank Street
Mickel Furnace
Fever River
Boutellier
Brick Yard
Scale of 4 chains to an Inch

gesting a type of business occupance making use of the stream. Farther north the principal part of the town was kept at a distance of several rods from the river by what appears to be a swamp. One marvels at the change that has occurred in Fever River in the course of a little over a century, shrinking from a navigable river 265 to 375 feet wide opposite Galena in 1827, to an insignificant stream measuring eighty feet across at the present time.

Galena immediately became not only an important smelting and mining center, but even more noteworthy, it was almost the single gateway by which settlers entered the mining area, the only important town and supply center for provisions, general merchandise, and equipment, and practically the one shipping point for lead produced within the entire region. Not only was it on Fever River, the one branch of the Mississippi within the lead region that was navigable for steamboats, but more specifically, it was at the head of navigation on that branch.[56] At about the foot of Franklin Street in present-day Galena was a shallow place in the river where in early days was located a ford that could be used during periods of low water. Downstream from this ford to the mouth of the river there is said to have been a depth of twelve to sixteen feet at low water.[57] At times of high water boats could go some distance above the ford, but in general it seems to have set the limits of normal steamboat navigation and created the need for a settlement at this cargo-breaking point.

Houses of the early miners at Galena and elsewhere in the general lead region, although always crude, varied considerably in materials and form.[58] Small rectangular log cabins ten to fourteen on a side, chinked with stone

[56] John Reynolds, *My Own Times,* p. 168. Chicago Historical Society, Chicago, 1887.

[57] *History of Jo Daviess County, cit.,* p. 242. This figure seems almost unbelievable when one observes that 40 to 50 years later even the smallest steamboats at low water could not get closer than two miles from Galena. There is practically no current in the river at Galena, the stage of water depending entirely on the height of water in the Mississippi. The difference between extreme high and low water is 17 feet at the Galena levee. There appear to be no official figures for early depths of water in the Galena River, but one report by a United States Engineer written in 1873 states that upon the most reliable information to be obtained, there was, 30 years previously, a 10-foot depth of water in the river. Because of the lack of current, silting of the channel was very rapid after the surrounding hill slopes were cleared of their timber, and cultivated fields replaced the original forest and prairie cover. See *Report of the Chief of Engineers, 1874,* vol. I, pp. 290–291.

[58] *History of LaFayette County,* p. 445. Chicago, 1881; Holford, *op. cit.,* pp. 18, 542, 561; *History of Iowa County, Wisconsin,* pp. 465, 656. Chicago, 1881; *Senate Document 349, 26th Congress, 1839–40,* vol. VI; *Niles Weekly Register,* vol. 65, p. 161; *Wis. Hist. Colls.,* II, pp. 332, 486; X, p. 266.

and plastered with lime mortar, with roofs of sod, bark, or hand split boards, and with earthen floors were one of the most standard permanent types of residence. These whitewashed one-story structures were sometimes of the double-log-house type with a middle passage, reminiscent of the South. Heat was furnished by fireplaces made of stone or earth, while chimneys were of stone, or sand cemented with clay. Tents, wagon boxes turned upside down, or a lean-to of poles covered with bark often served as temporary shelters until the more permanent quarters were completed. Sod houses were also common, especially in localities where timber was not abundant. These were ofttimes roofed with a thatch of prairie grasses, or with poles covered with earth. Rough stone was also occasionally employed as building material. The crudest form of shelter, and by no means uncommon for miners without families, was the dugout excavated in the hillside. It is from these semi-subterranean dwellings that the name "Badgers," as applied to the mining population, comes. A front or outside wall of logs was occasionally added to the hillside home which gave it an appearance of greater respectability.

Settlements Other Than Galena

If the estimate of 10,000 inhabitants within the Wisconsin-Illinois lead area by about 1828 is reasonably correct, it becomes clear that a large majority of the new arrivals were not living in compact settlements. Loose clusters of isolated cabins located with respect to the principal proved ore-bearing crevices were the representative settlement type. Such loose clusters are shown as "diggings" on the Chandler Map (Fig. 5). Besides the miners' cabins a diggings area was characterized by numerous excavations and associated dump heaps, the active shafts capped by the ubiquitous windlass. Small plots of cultivated land lay adjacent to some of the cabins. The extensive areas between the diggings, except for trails, usually were entirely devoid of settlement forms. The pattern of settlement was neither completely dispersed nor agglomerated, but was uniquely middle ground in character. Unlike farm land, lead was not universally available, and it was the centripetal force of the important ore veins that produced the loose clusters of miners' residences. On the other hand, compact agglomerations of conspicuous size were discouraged by the scattered nature of the lead deposits within a local mining area, the danger of claim jumping, the ease with which accumulated lead supplies could be thieved, and the shifting character of the population.

Incipient villages some of these loose clusters of mining cabins certainly were, and with the addition of a store, tavern, blacksmith shop, and several smelting furnaces, a number of them appear to have developed

increased compactness, if not an actual commercial nucleus. Whether street pattern, which is one of the distinguishing marks of a village, had become at all evident by the close of the third decade of the century in any of the settlements except Galena, it is impossible to say. There are no descriptions of pattern or arrangement extant for any of them. By what criteria Chandler differentiated between the various mining clusters, mapping some as villages and others as just diggings is not known. On his map (Fig. 5) eleven places, other than Galena, are marked with the village symbol. All of the eleven were located within what is now Wisconsin. Some, if not most, of the settlements which in 1828 appeared to be developing village stature, were ghost towns a year later as a result of the depression in lead prices and the Indian uprising that followed. On the map of southwestern Wisconsin compiled from the records of the original land surveyors (1832–1833) only seven or eight villages are indicated (Fig. 7).

In present-day Iowa County (Wis.) two settlement centers, Dodgeville and Mineral Point had begun to stand out from among the others. As early as 1828 the former possessed several stores, two combination taverns and boarding houses, a blacksmith shop, and two furnaces.[59] At the Mineral Point site not only were there some of the lead region's most profitable ore-bearing crevices, but a further attraction to settlers was the available water supply from Jerusalem Spring. It was around this spring that the earliest mining cabins were grouped. One or more stores, blacksmith shops, and smelting furnaces were in operation in 1829.[60] Old Helena, or Arena as it was then called, located on the south bank of the Wisconsin River, had its origin as a shipping center for lead from Dodge's mine and others in the northern part of the region. Here flatboats were built and on them lead was floated down to St. Louis. In addition to the small cluster of houses at Old Helena there was a store, a government warehuose for storing lead and supplies, an inn, and the beginning of a shot tower, which was not completed until after the Black Hawk War. The town was demolished by the soldiers in pursuit of Black Hawk and his warriors, who used the logs and planks of the settlement's buildings to construct rafts for transporting troops across the Wisconsin River.[61]

In present-day LaFayette County there were noteworthy settlements near what is now White Oak Springs and at Natchez about one and a half miles down valley from present-day New Diggings. Traces of both have completely disappeared. Each is estimated to have contained at least 100 residents.[62] Another important diggings area was at Gratiot's Grove,

[59] *History of Iowa County, Wisconsin, cit.*, pp. 732–742.
[60] *Ibid.*, pp. 651–659.
[61] *Wis. Hist. Colls.* XIII, pp. 335–374; Schafer, *op. cit.*, pp. 196–197.
[62] *History of LaFayette County, cit.*, p. 585.

where at one time six to nine log smelting furnaces were in operation. Chandler does not designate it as a village, although one writer estimated that the Gratiot's Grove settlement prior to 1830 had 1500 inhabitants and called it the most important mining center outside of Galena.[63] Lucius Lyon, who surveyed the region for the Federal government in 1832, states that there had been not less than forty families there in more prosperous days. The same note was made concerning Shullsburg, although both places had shrunk to five or six families at the time of the survey.

Within modern Grant County Platteville had approximately 150 inhabitants by 1828 or 1829 and contained at least one store, a smelting furnace, and a post office.[64]

MINING[65]

Practically all of the lead (sulphide of lead) in the Upper Mississippi mining area is contained within the Galena dolomite and usually within twenty to forty feet of the surface. The ore exists in vertical crevices, the principal ones trending east-west, the north-south and the quartering crevices being fewer and less productive. Good mineral bearing veins ordinarily did not occur singly but in groups, and it was the searching out and discovery of these principal groups of parallel veins that marked the exploratory period within the region. Many of them had already been located by 1830 and were at that time the foci of settlement. Few important mines existed outside of these principal mineral bearing areas, which are shown with great clarity on the Chandler Map. Probably less than eight per cent of the total area was included within the districts of mining concentration.[66]

[63] *Wis. Hist. Colls.*, X, p. 246.

[64] Holford, *op. cit.*, pp. 453–456.

[65] A relatively complete account of early mining in the three southwestern counties of Wisconsin is available in Schafer, *op. cit.*

[66] Listed below are those parts of the region which in places were so honeycombed with mines, and so roughened with their dump heaps that their agricultural development was retarded. (Schafer, *op. cit.*, pp. 131–132). Even down to the present time one can observe areas of pitted mining terrain which have remained out of cultivation. Township 1, range 1 east and range 1 west, containing the villages of Benton, New Diggings, and Hazel Green; the eastern tier of sections in township 1, range 2 west (Jamestown), the northern half of township 1, range 2 east (Shullsburg); township 3, range 1 west (Platteville); the south-east quarter of township 3, range 3 west (Potosi); a half township in Beetown and Glen Haven, a half township in Mineral Point and Linden, a half township in Dodgeville and Ridgeway. See also Wisconsin Geological and Natural History Survey, *Bulletin XIV, Lead and Zinc Deposits Atlas,* containing maps on scale of 4 inches to the mile, showing locations of old diggings as well as newer shafts.

In the identification of the principal ore-bearing districts, there was slight application of scientific techniques. In some instances earlier Indian diggings offered clues as to the whereabouts of lead, but more often the seasoned prospectors from the Missouri or the Dubuque mines were guided by certain surface indications. Among these were the discovery of float lead at or near the surface, sink holes, especially when in a line, hillside springs, slight linear depressions in the surface, and certain peculiarities of slope conformation, such as a bench, step, or slight undulation. Many other "mineral signs" of a superstitious character were also prevalent and it was these probably that led to much random and fruitless digging.

Before the genuine rush of miners to the lead region set in, the government had already established a system of land control for mining areas. All of the mineral bearing lands were reserved by the government and the mining and smelting of lead was sanctioned through a leasing system under which a tithe of the lead raised belonged to the government. Much illegal mining resulted from the leasing and tithe system employed so that eventually it was discontinued. To obtain a government permit to mine, two or more men were obliged to work together. Each man was permitted to stake off a plot of land 300 yards square, the boundaries of which followed the cardinal directions.[67] A quarter acre was granted for the raising of food crops, but general agriculture in the mining lands was expressly forbidden, since it tended to obliterate "mineral signs." For every two helpers employed an additional unit of mining land was permitted. When surveys of lead discoveries were required they were for plots twenty by forty rods in dimensions, the length to correspond with the direction of the ore vein. In order to obtain a lease the miner agreed to sell his ore to a publicly licensed smelter where the government's tithe was taken out. Leases of half a section were made to public smelters and to persons agreeing to employ 20 laborers in mining operations. As a general rule, mining and smelting leases were located in the rough and broken lands bordering valleys, where timber was available. At the time probably not more than one tenth of the entire lead area was covered by timber.[68] The extensive prairie interfluves, which at a later date became the select agricultural land, were less desirable locations for mining. This was partly because of the large requirements of timber and wood in mining, and more especially smelting, operations.

[67] *History of Jo Daviess County, cit.*, pp. 261–262. Other sources indicate that the unit mining area was 200 yards square. *Ibid.*, p. 252–253; also Chandler's Map, *op. cit.; History of Grant County, cit.*, p. 407; Schafer, *op. cit.*, p. 132. It is possible that size of the unit mining area as defined by the Superintendent of the U. S. Lead Mines early in 1825 (300 yds. sq.) was subsequently reduced.

[68] Chandler's Map, marginal notes.

In addition there was an actual concentration of ore bearing crevices along drainage lines, for the lead probably was deposited from mineralizing solutions from above, which made surface relief one of the important localizing factors.[69]

Most mines were of the vertical shaft type and usually not over forty feet in depth. An ordinary wooden windlass was used for lifting rock and ore from the shaft. Smelting processes were crude and inefficient and the first furnaces were patterned after those in use by the Indians, who in turn had been taught by the early French. There were a number of variations in furnace form, but essentially it was a shallow hopper-like hillside excavation, two to three feet wide at the top, connected at its narrowing bottom by a trench to a shallow depression designed to catch the flow of molten lead from the hopper. A grate of narrow stones at the bottom of the hopper was covered with small logs and on these the charge of mineral was placed. The trench under the hopper from which the heat was applied was filled with quick-burning light wood.

The log furnace was a big improvement over the Indian smelting pit just described. It too was a hillside structure, with three walls, usually of local stone, forming a rectangle eight feet long by four feet wide, and the steeply sloping ground providing the fourth wall and bottom. Flat stones paved the bottom, with some irregular ones along the margins to prevent the logs from lying flat on the floor, thereby obstructing the flow of lead. Holes in the base of the lower wall provided an outlet for the molten lead and draft for the furnace. A layer of four-foot logs on the bottom supported the charge of about 2500 pounds of ore, while smaller wood standing vertically lined the three walls of the furnace. Wood was constantly added from above until the under logs finally burned out.[70] Even in this improved type of furnace probably not more than fifty to sixty per cent of the lead was recovered. At the time of government land survey of southwestern Wisconsin in 1832–1833, eighteen lead furnaces were observed in that section of the general Upper Mississippi mining region (Fig. 7).

Transport of the smelted lead was by ox or horse-drawn wagon acrosscountry over unimproved trails, almost exclusively to Galena. On occasions trifling amounts may have gone east by way of the Fox-Wisconsin-Great Lakes route, and a little also went down the Wisconsin to the Mississippi. The first wagon load of lead reached Chicago from Galena in 1829.

[69] G. H. Cox, "Lead and Zinc Deposits of Northwestern Illinois," *Bull. 21, Ill. State Geol. Survey*, pp. 46–118, 103–104. Urbana, 1914. See also *Galena Democrat*, II, no. 59, Sept. 12, 1840.

[70] Henry R. Schoolcraft, *View of the Lead Mines of Missouri*, pp. 94–100. See also Schafer, *op. cit.*, pp. 34 and 100–103 and Cox, *op. cit.*, pp. 14–15.

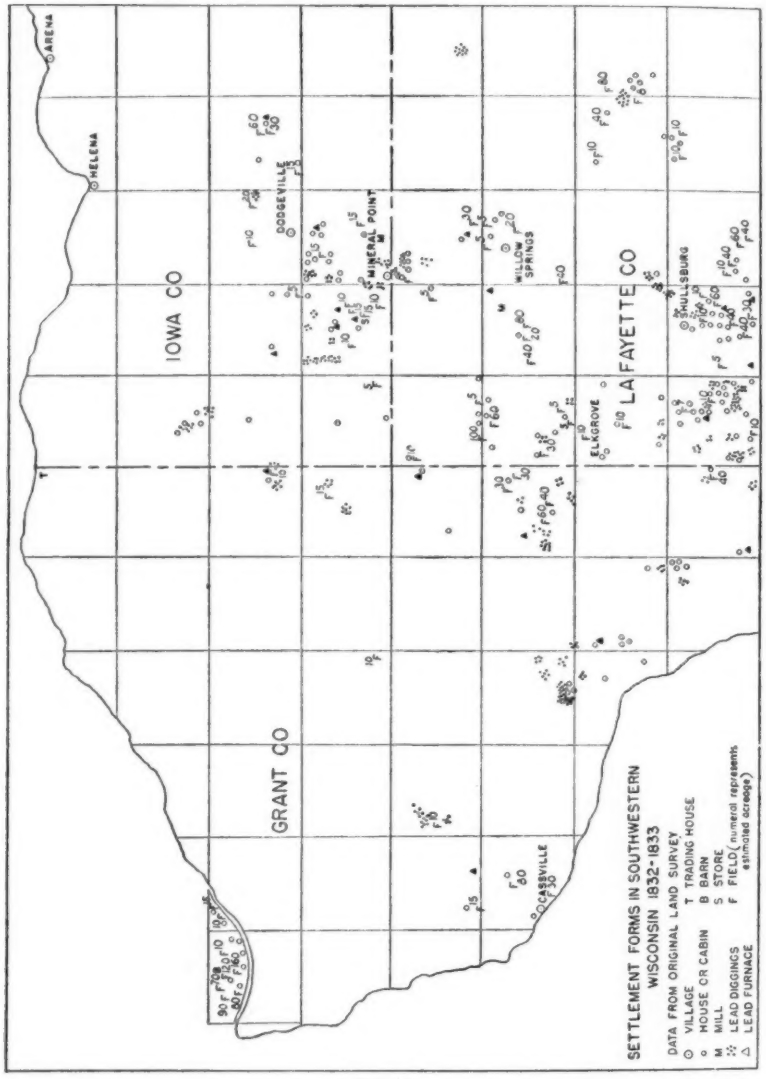

ARENA
HELENA
IOWA CO
GRANT CO
LAFAYETTE CO
DODGEVILLE
MINERAL POINT
WILLOW SPRINGS
ELKGROVE
HULLSBURG
CASSEVILLE
SETTLEMENT FORMS IN SOUTHWESTERN WISCONSIN 1832-1833
DATA FROM ORIGINAL LAND SURVEY
VILLAGE
HOUSE OR CABIN
MILL
LEAD DIGGINGS
LEAD FURNACE
TRADING HOUSE
BARN
STORE
FIELD (numeral represents estimated acreage)

FIG. 7.

The practical monopoly which Galena enjoyed as lead shipping center for the entire region was instrumental in setting the road pattern (See Chandler's Map). Other than the main east-west government road along Military Ridge connecting the forts and settlements at Prairie du Chien and Portage, nearly all focused on Galena. One or two trails led northward from Military Ridge to the Wisconsin River, but within the period under discussion these were relatively unimportant. Wagons carting lead to Galena, returned to the mining settlements with loads of provisions, equipment, and other necessary merchandise. Teaming services were so much in demand that a considerable element of the frontier population was engaged in hauling to and from Galena. It is said that many men with teams and wagons came up from the central and southern Illinois settlements in spring, remained throughout the warmer months when natural food for their animals was abundant, and returned south in winter.[71]

Practically all of the lead from the Upper Mississippi mines went down river to St. Louis and New Orleans, and thence to New York. At first transportation was by keel boat but after 1825 more and more went by steamboat. Although the first load of lead to leave Galena by steamboat was in 1822, it was not until about five years later that there was regular steam service between St. Louis and Fever River. In 1828, ninety-nine steamboats arrived at Galena, compared with seventy-four keel boats.[72] The importance of the lead cargo leaving Galena during this first decade of American mining is indicated by the following table. Figures from three sources are offered, both for the sake of comparison and because they are somewhat complementary. That they do not agree exactly is to be expected, since no official statistics of lead production were kept and the figures are for the most part only estimates.

LEAD PRODUCED IN THE UPPER MISSISSIPPI MINES

	First Source[73]	*Second Source*[74]	*Third Source*[75]
1823	..... pounds	335,130 pounds	150 tons
1824	..... "	175,220 "	78 "
1825	439,473 "	664,530 "	297 "
1826	1,560,530 "	958,842 "	428 "
1827	6,824,339 "	5,182,180 "	2,313 "
1828	12,957,000 "	11,105,810 "	4,958 "
1829	.....	13,343,150 "	5,597 "
1830	.....	.....	5,331 "
1831	.....	.....	5,369 "
1832	.....	.....	5,401 "

[71] *Wis. Hist. Colls.*, X, p. 260; also *History of Jo Daviess County, cit.*, p. 267.
[72] Chandler's Map of 1829, marginal notes.

AGRICULTURE

In the Upper Mississippi mining region early selection of land for settlement was almost entirely with an eye to its probable production of lead and timber. Agriculture was practically ignored. Since both lead and timber were fairly coincident with the slope lands bordering river valleys, the policy of land selection resulted in the extensive prairie uplands remaining largely unused. Within the government's reserved mineral lands, as indicated earlier, agriculture was definitely discouraged, and only farms of garden size were legal although this restriction was not vigorously enforced. Where tillage could be carried on without interfering with the timber needed for mining and smelting, and where evidences of lead were lacking, it was permitted free of rent.[76] On Chandler's Map of 1829 seven farms are shown, but quite likely those were the very conspicuous ones and some probably were missed. Three of the seven were in the vicinity of Galena where was the single largest market for farm products. The other four were in what is now Wisconsin and were well scattered.

What is certainly a more detailed, and probably also a more accurate, representation of land in agricultural use within this region, is furnished by the United States land surveyors' observations in 1832–1834 (Fig. 7). From their notebooks and maps one learns that within what is now the three southwestern counties of Wisconsin they observed approximately sixty-five separate parcels of cultivated land. No recorded estimate of the size of each field was made by the surveyor, but on his map the fields appear to have been drawn roughly to scale. From these maps I have estimated the approximate area of each field. The total area under cultivation as obtained by this rough computation was 1600 ± acres or two-and-one-half sections of land. Thirty of the sixty-five fields were under ten acres in size and this group contained fifteen per cent of the total cultivated area; sixteen fields were between eleven and thirty acres in size and together they comprised 360 acres (22.5 per cent); nine fields were within the 31–50 acre group and contained 360 acres (22.5 per cent); while nine fields were be-

[73] These statistics for lead smelted in the Wisconsin-Illinois mining area appear on the margins of Chandler's original map.

[74] D. D. Owen, *Senate Doc. 407, 28th Congress, 1st Session*, p. 46, (Serial number 437).

[75] Josiah D. Whitney, *The Metallic Wealth of the United States, Described and Compared with that of Other Countries*, p. 421. Philadelphia, 1854. For a more complete presentation of lead statistics see, Selma L. Schubring, "A Statistical Study of Lead and Zinc Mining in Wisconsin," *Transactions Wisconsin Academy of Science: Arts and Letters*, vol. XXII, pp. 10–98, Exhibit I.

[76] Chandler's Map (Fig. 5), marginal notes.

tween fifty and 100 acres with a combined area of 640 acres or forty per cent. It is reasonably certain therefore that within the Wisconsin section of the lead mining region there were at least nine cultivated tracts of conspicuous size in 1832–1833. Corn, oats, and wheat appear to have been the most important crops.

A check of all the fields on the surveyors' maps with respect to their locations in either prairie or woodland, showed that about sixty per cent of them were within the grasslands. With few exceptions, however, they were just outside the timber and therefore enjoyed the advantage of marginal location between grass and woodland. The higher and more exposed central parts of the prairie interfluves, where timber was scarce, water difficult to obtain, and mining settlements farther removed, were avoided.

Chief stimulus to small-scale agricultural operations was the high cash prices for food supplies obtainable at the mining settlements. Imported food coming up river by boat was costly and difficult to obtain, and during winter months when the Mississippi was closed, near famine conditions occasionally prevailed. Yet, even as late as 1835 one traveler in the region estimated that not one-twentieth of the food required by the mining population was produced locally.[77]

To grind the local grain, grist mills were established at certain strategic sites along streams. On Chandler's Map of 1829, five such mills are shown, four of them within the Illinois section and therefore capable of serving the Galena settlement. The fifth was on Platte River in southwestern Grant County.

CONCLUSION

With the opening of the Driftless Hill Land to agricultural settlers after 1832–33 there was terminated a long period of almost exclusive destructive exploitation. For more than a century and a half furs and minerals, and to a less degree military needs, had motivated the white invasion. But although half as long again as the agricultural period that followed, the marks left upon the earth by trader and miner were not abundant. Their canoes and keel boats slipped through the inland waters and, unlike land vehicles, left no trace of their passing. The fabric of this predominantly male civilization was extensive, loose, and shifting in character. Of French occupance, with its characteristic riverside stockaded trading posts, scarcely a bit of material evidence remains; even the sites of a number of the posts are not known with certainty. The three quarters of a century that followed French abdication, was not quite so barren of enduring cul-

[77] Hon. Charles Augustus Murray, *Travels in North America*, p. 133. London 1841.

ture forms, for a few present-day settlements, at least had their beginnings during this latter exploitive substage. Three occupance centers stand out prominently: (1) the fur trading-military settlement at Prairie du Chien; (2) the lead mining and pelt collecting community at Dubuque's mines; and (3) the lead mining region south of the Wisconsin River with Galena on navigable Fever River as its outstanding focus. In all three the community form of settlement was prominent although in the Wisconsin-Illinois lead area numerous miners' cabins were isolated even though contained within loose clusters. The few independent farming enterprises that had developed by 1830 were almost entirely parasitic in character. Destructive exploitation economies prevailed. Thus to the agricultural settlers of the 1830's and 1840's most of the soil within the Driftless Hill Land was still in a virginal state.

University of Wisconsin,
May, 1939.